CROSSBAR DIAL SYSTEM

SECTION II - EQUIPMENT ARRANGEMENT WITH TRAFFIC AND CIRCUIT FUNCTIONS OF CROSSBAR SYSTEM FRAMES

TABLE OF CONTENTS

CHAPTER	SUBJECT
5	Line Link Frame - District Junctor Distribution
6	Subscriber Sender Link, District Junctor, and District Link Frames - Zone Registration
7	Office Link Frame - Office Junctor Distribution
8	Originating Sender and Originating Marker Connector Frames
9	Originating Marker Frame
10	Terminating Sender Link, Incoming Trunk, and Incoming Link Frames - Line Junctor Distribution
11	Terminating Senders, Number Group Connector, Block Relay, and Terminating Marker Frames - Line Test
12	Line Choice Connector, Line Junctor Connector, and Terminating Marker Frames - Channel Selection - Trouble Indicators

BELL TELEPHONE LABORATORIES, INC.
SYSTEMS DEVELOPMENT DEPARTMENT
463 WEST STREET
NEW YORK CITY

(ISSUED FOR TRAINING PURPOSES ONLY)

SECTION II - EQUIPMENT ARRANGEMENT WITH TRAFFIC AND CIRCUIT FUNCTIONS OF CROSSBAR SYSTEM FRAMES

CHAPTER 5 - LINE LINK FRAME - DISTRICT JUNCTOR DISTRIBUTION

In the previous chapters a very general description of the crossbar office was given and some of the functions of the various frames were discussed. In the next few chapters, the functions and traffic features of the crossbar frames will be discussed in greater detail - still, however, without recourse to circuits. This discussion should tend to build up a further familiarity with the crossbar office before beginning the study of the actual crossbar circuits. With this method of approach, the line link frame first presents itself for further analysis.

DESCRIPTION OF LINE LINK FRAME

The equipment arrangement of the line link frame was illustrated in a previous chapter. It consists essentially of an originating unit mounting ten secondary and ten primary switches together with the necessary controller equipment as illustrated. The primary bay which is part of the originating unit serves 190 subscriber lines. These lines are divided into ten horizontal groups on ten 200 point switches. One vertical in each horizontal group is reserved for no-test calls for use when it is necessary for an operator to connect to a busy line. Where the calling rate of the lines to be served permits, the frame may be built out to serve a larger number of lines by adding supplementary primary bays. This may be done in increments of 100 or 200 lines. The originating unit together with the required number of supplementary primary bays constitutes a line link frame or "line group" (see Fig. 3, Chapter 2).

LINE CIRCUIT AND LINE CONNECTOR CIRCUIT

As stated previously each subscriber has the exclusive use of one vertical of a primary switch. The line relay for a particular line is located beneath the associated primary switch and the holding magnet of the vertical acts as the cut-off relay for the line. The subscriber lines are arranged for circuit purposes in groups of ten, each group of ten having a start lead to the controller. In addition to the start leads each line is provided with a test lead to be connected to the controller for the purpose of identifying the calling line. In order to permit the controller to gain access to these test leads and also to the windings of the primary holding magnets, each group of ten lines is provided with a line connector circuit consisting of two relays which may be operated by the controller. The line connector circuit for each group of ten lines is located adjacent to the associated line relays.

LINE LINK HORIZONTAL MULTIPLE

As stated previously, the line links are multipled horizontally across the individual terminals of the primary switch, ten links per horizontal group. This consists of bare wire strapping across the individual terminals of each primary switch. Where there is more than one primary switch per horizontal group, multiple local cable forms are employed to extend the line link multiple from one primary bay to the next in each horizontal group. The line links are distributed to the horizontals of the secondary switches in the main local cable, each primary switch having one line link to each secondary switch. Horizontal strapping is also employed to extend the line links across the verticals of the secondary switches.

HORIZONTAL GROUP CIRCUIT

The horizontal group circuit which is part of the line link controller consists of a multicontact relay and ~~two~~ one "U" type relays per horizontal group, arranged to connect the test and control leads for the horizontal groups to the controller. The multicontact relays for the ten horizontal groups are mounted directly above the controller circuit and their common terminals are connected together by means of horizontal strapping. The common strapping for these relays is also connected to a terminal strip for connection by local cable to the controller circuit.

CONTROLLER-HOME AND MATE CONTROL OPERATION

As previously stated, each line link frame is provided with a controller whose function it is to recognize a calling line, assist the sender link controller in selecting an idle line link and an idle district junctor, and in operating the necessary selecting and holding magnets for connecting these paths to the calling line. Since the controller is offered for the common use of a group of lines which may vary in size from 190 to 690, its failure would put that number of lines out of service, if no provision were made for emergency operation. As a protection against this, line link frames are arranged to work in pairs, the controller on one frame acting as an emergency control circuit for the other.

CONTROLLER CONNECTOR CIRCUIT

The controller connector circuit consists of two sets of relays one of which connects the test leads from the frame to the home controller and the other to the mate controller.

START CIRCUIT

The start circuit on each line link frame consists of two channels referred to as "A" and "B" channels. Under normal operation the "A" channel will be used for each call and the operation of a line relay will cause this channel to function to choose the home controller to handle the call. When due to a trouble condition the home controller is not available to handle calls, the "B" channel of the start circuit will function and the controller on the mate line link frame will serve the call. Under these conditions both line link frames will use the same controller, each frame alternating in its use if calls are waiting until the trouble condition is cleared.

LINE LINK FUNCTIONS-ORIGINATING CALLS

The line link controller in cooperation with the subscriber sender link controller is responsible for connecting a calling line to a district junctor and through the subscriber sender link to a subscriber sender. This process takes place before dial tone is given to the subscriber.

IDENTIFICATION OF CALLING LINE

In order to connect a particular calling line to a line link and district junctor, the line link controller must first identify the calling line. This is done by means of the horizontal group circuit in conjunction with a series of "vertical group" relays in the controller. All groups of ten lines each in the same horizontal group will give the same horizontal group indication. Each of these groups will, however, give a different vertical group indication so that by means of the two indications the control circuit will recognize a particular group of ten lines. It will then operate the line connector relays to connect the test leads and holding magnet operating leads for this group to the controller. Since the test leads for only one group of ten lines are connected at a time to the controller it can identify which one of the ten is calling.

ORDER OF HANDLING CALLS

When simultaneous calls exist in more than one horizontal group, a call in the lowest numbered horizontal group will be handled first. After this call is connected to a sender a call in the next lowest numbered horizontal group will be handled. Where simultaneous calls exist in the same horizontal group the call in the lowest numbered vertical group will be first handled.

CHOICE OF IDLE DISTRICT JUNCTOR

Assuming that there are idle district junctors available on each secondary switch and that waiting calls are distributed evenly over the horizontal groups, the controller will assign calls alternately to two groups of ten district junctors until nine district junctors in each of these two groups are busy. Thereafter, it will assign calls to succeeding groups of ten district junctors on the frame until nine calls have been assigned in each group. One district junctor in each sub-group is always held in reserve until no district junctors but those reserved are available for calls. When this condition arises the reserved district junctors will be assigned. The alternation in assignment for the first two groups referred to above insures that a subscriber will not be assigned the same facilities on a second attempt during periods of light traffic.

The purpose of holding one district junctor in reserve in each group of ten is to minimize the possibility of "blocking". Blocking of calls in the line link primary-secondary spread occurs when there are idle line links available in a particular group but no district junctors. Since the district junctors are multipled to a number of line link frames, they can be made busy by any line link frame having access to them. The reserve feature therefore, tends to insure full usage of the links on the various frames by increasing the possibility of an idle line link finding an idle district junctor.

To insure the rotation of assignment of the district junctors in each sub-group of ten, the district junctors in the sub-group are assigned in accordance with which line in the group of ten connected to the control circuit is calling. This is a purely arbitrary method of assignment and has nothing to do with the importance of the various lines in a group of ten.

CHOICE OF IDLE LINE LINK

For each group of ten district junctors appearing on the same secondary switch there is one line link from the horizontal group in which a calling line appears. Although the previous paragraph discussed the normal rotation in the assignment of calls to the various groups of ten district junctors this rotation is, of course, affected by whether or not there is available a line link into the particular secondary switch on which a given group of district junctors appears. The ten line link test leads for the horizontal group are connected by the horizontal group connector relay to the controller where the busy line links operate relays which bar the use of the corresponding sub-groups of district junctors. Of those line links which are idle, the one corresponding to the sub-group of districts which would normally be assigned in the regular assignment sequence will be used. The assignment of a group of district junctors is made only when there is access available from the district junctors in question through the subscriber sender link to an idle sender.

DISTRICT JUNCTOR LOCKOUT

Since a group of district junctors appears on more than one line link frame, there will be times when more than one line link frame will wish to assign a call in the same district junctor group. There is a lockout chain between the various appearances of a group of district junctors. The line link frame which first succeeds in gaining access to the group will lock out the others momentarily until it has obtained an idle district junctor and the calling line has been connected to a sender.

CLASS OF SERVICE INDICATIONS

Under certain conditions it will be necessary to put subscriber lines of different classes of service in the same line group (line link frame). In general, line link frames are classed as flat rate, message rate, message rate two party or coin. However, under each of these classifications there may be different classes of subscribers requiring separate treatment on certain calls. Thus, one flat rate subscriber may be permitted unlimited calls to other local offices while another may be permitted unlimited calls in one metropolitan zone while he should be charged for calls to other zones. Provision is made for each line to give a class of service indication to the subscriber sender.

Associated with each group of twenty district junctors are class of service leads which are connected through the subscriber sender link to the sender. On a particular line link frame the lines requiring different class of service treatment are arranged in each group of ten lines in a uniform manner for all groups of ten lines on the frame. When a group of ten lines is connected to the control circuit, a line in a given position in the group of ten will give the same class of service indication regardless of which group of ten lines on the frame it is in. Any line link frame may give a total of four class of service indications to the sender. These indications are transmitted to a group of ten terminal strip punchings which are cross connected to the class of service leads to the sender as required for a particular line link frame. The class of service indication for the calling line is transmitted to the marker by the sender on each call. From this indication the originating marker will set the district junctor to charge as required in accordance with the class of service of a particular line.

LINE LINK FUNCTIONS - TERMINATING CALLS

When a terminating call is to be completed on a given line link frame, the terminating marker, through the line choice connector frame, (after the completion of any originating call which may be in progress at the moment) obtains control of the line link frame and locks out other originating or completing calls momentarily. As soon as this is done the line choice connector under control of the terminating marker will operate the horizontal group circuit relay corresponding to the horizontal group in which the called line appears. The horizontal group relay gives the marker control over the ten line links in the particular horizontal group and enables it to choose an idle line link over which to complete the call. Having chosen the combination of line link, line junctor, and incoming link to be used for the call, the marker operates the necessary selecting and holding magnets on the line link switches to connect the line over a line link to a line junctor. At the conclusion of these operations the controller is released to permit it to handle another call.

Where both originating and terminating calls are waiting for the use of the line link controller originating and terminating calls will be served alternately.

TRAFFIC ANALYSIS

It is assumed that the safe originating and terminating traffic carried by the ten line links of a horizontal group can be 100 ccs. or 1000 ccs. per line link frame. This is calculated in terms of a loss of one percent between the line and the district junctor. Lost calls will occur due either to the failure of a call to find an idle line link in a horizontal group or to blocking in the primary to secondary link distribution.

SIZE OF LINE LINK FRAME

The number of lines which can be served by a given line link frame is calculated on the basis of the combined originating and terminating traffic per line. As an illustration, assume this total to be 2.0 ccs. per line. 1000 ccs. (the total for the frame) divided by two equals 500 or the number of lines having a combined traffic of 2.0 ccs. which can be served by one line link frame. Now the primary bay arrangements which have been made available will permit line link frames with a capacity of either 490 lines or 590 lines. Since it is necessary to provide a certain number of spare line circuits on each line link frame for traffic rearrangements only about 480 working lines would be assigned to a line link frame having 490 lines capacity. Since this is less than the 500 allowable, it would probably be desirable to provide a line link frame with 590 lines capacity with 500 working in this case.

DISTRICT JUNCTOR MULTIPLE

The 100 line links of a given line link frame deliver originating traffic to 100 district junctors. With a loss of one percent of the calls originated due to an all busy condition, the 100 district junctors will carry 2500 ccs. Assuming for purposes of illustration that one-half of the traffic of the lines on a given line link frame is originating, 500 ccs. will be delivered to the district junctors. It is evident that in order to fully load the district junctors it will be necessary to multiple them to other line link frames requiring access to district junctors offering the same class of service. If the other line link frames to which the district junctors are multipled also deliver approximately 500 ccs. of originating traffic each, the district junctors can be multipled five times.

DISTRICT JUNCTOR DISTRIBUTION

In line with the above discussion it should be pointed out that the 100 district junctors from a given line link frame are not multipled intact nor do they go to only one district frame. District junctors are multipled in groups of twenty and the 100 from one line link frame are carried as far as possible to five different district frames. In addition, the district junctors appearing on one district link frame are scattered in groups of twenty as far as possible over the various line link frames in the office.

The spreading of the district junctors from line link frames to as many district link frames as possible (five if practicable) is for the purpose of minimizing the effect on a line link frame of a trouble condition affecting the whole of a district link or subscriber sender link frame. Fig. 1 illustrates a typical example of the distribution of district junctors from line link frames to district frames. The distribution shown assumes a total of 49 line link frames and ~~nine~~ eleven district frames. Only five of the line link frames are included.

The spreading of district junctors associated with a given district link frame over as many line link frames as possible is desirable from the point of view of spreading the originating traffic evenly over the district link frames. No two line link frames will deliver exactly the same proportion of the originating traffic of the office and this spread of the district junctor groups tends to equalize the originating traffic delivered to the district link frames. In line with this objective it is also desirable that succeeding line link frames shall reach different combinations of five district link frames. Fig. 2 illustrates the distribution of district junctors from district frames to line link frames. This is part of the same typical pattern illustrated on Fig.1. Only five of the nine district frames are shown.

The number of line link frames to which the various groups of district junctors will be multipled will depend on the amount of originating traffic delivered to the district junctors by the line links on the various line link frames. The example quoted previously showed the originating equalling the terminating traffic and required the district junctors to be multipled five times. Where the originating traffic exceeds the terminating it will not be necessary to multiple as many as five times in order to obtain the necessary 2500 ccs. for each district link frame. Where the terminating exceeds the originating the district junctors should be multipled more than five times. In actual practice all district junctor groups are not multipled the same number of times. The East 30th Street installation is an illustration of this in that some groups of district junctors are multipled five times and some six times (see Fig. 2).

The multipling of district junctors is done for each office in accordance with a predetermined pattern which must be revised to fit the requirements of each particular job. A district junctor grouping frame is provided to facilitate the multipling process. The district junctors are cabled to the grouping frame from the district junctor frame where they are combined with the associated control leads from the subscriber sender link and distributed to various combinations of line link secondary switches.

LEADS TO SUBSCRIBER SENDER LINK

For each group of twenty district junctors there is an associated group of miscellaneous control leads to the subscriber sender link. These include class of service leads and control leads between the line link and subscriber sender link used in the choice of district junctor on originating calls. These are cabled together with the associated district junctors and are carried with them to the grouping frame. From the grouping frame they are cabled separately to the subscriber sender link frames.

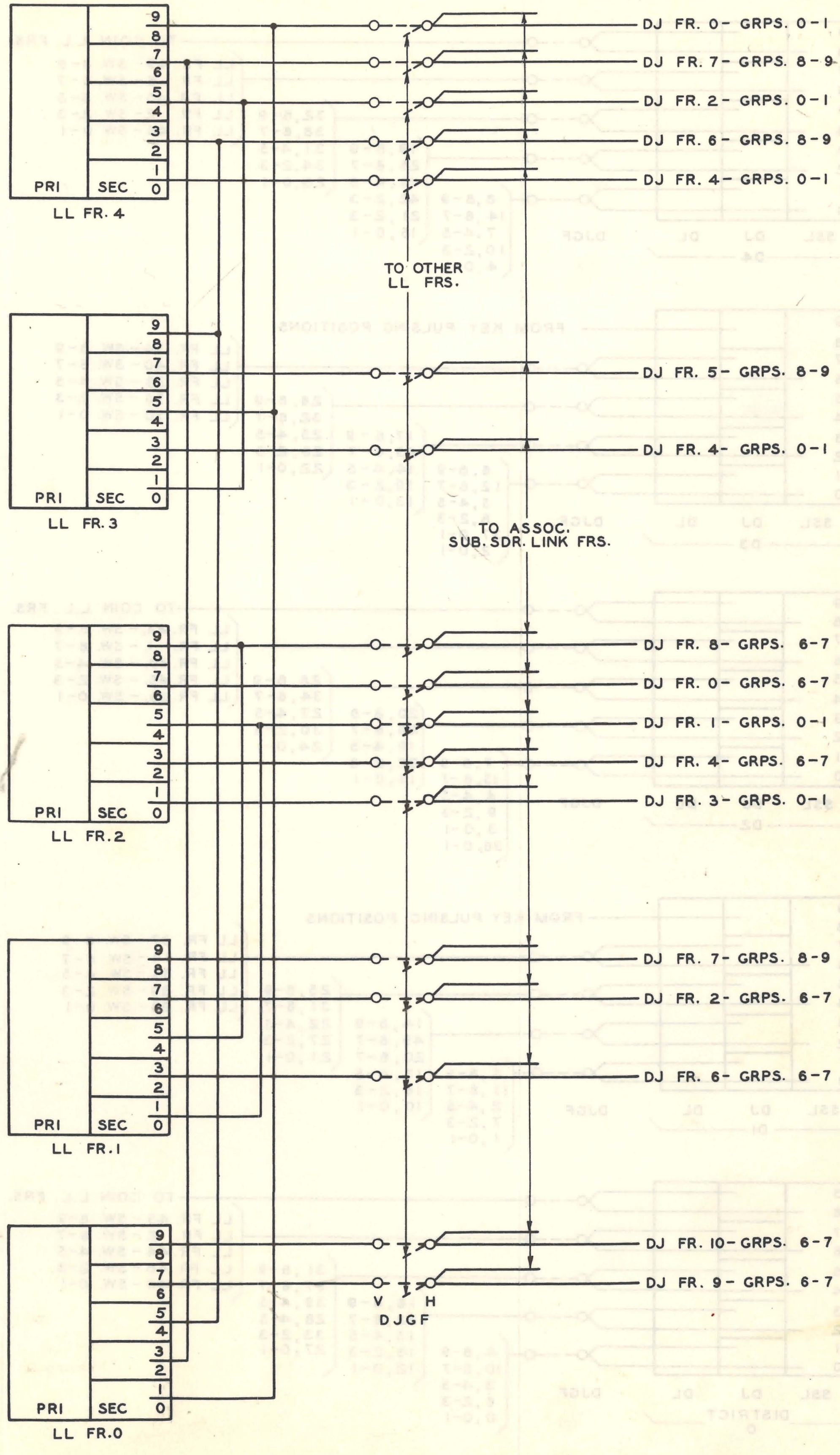

PRI
SEC
9
8
7
6
5
4
3
2
1
0
LL FR. 4
LL FR. 3
LL FR. 2
LL FR. 1
LL FR. 0
TO OTHER LL FRS.
TO ASSOC. SUB. SDR. LINK FRS.
V
H
DJGF
DJ FR. 0- GRPS. 0-1
DJ FR. 7- GRPS. 8-9
DJ FR. 2- GRPS. 0-1
DJ FR. 6- GRPS. 8-9
DJ FR. 4- GRPS. 0-1
DJ FR. 5- GRPS. 8-9
DJ FR. 4- GRPS. 0-1
DJ FR. 8- GRPS. 6-7
DJ FR. 0- GRPS. 6-7
DJ FR. 1- GRPS. 0-1
DJ FR. 4- GRPS. 6-7
DJ FR. 3- GRPS. 0-1
DJ FR. 7- GRPS. 8-9
DJ FR. 2- GRPS. 6-7
DJ FR. 6- GRPS. 6-7
DJ FR. 10- GRPS. 6-7
DJ FR. 9- GRPS. 6-7

Fig. 1 - Typical Distribution of District Junctors

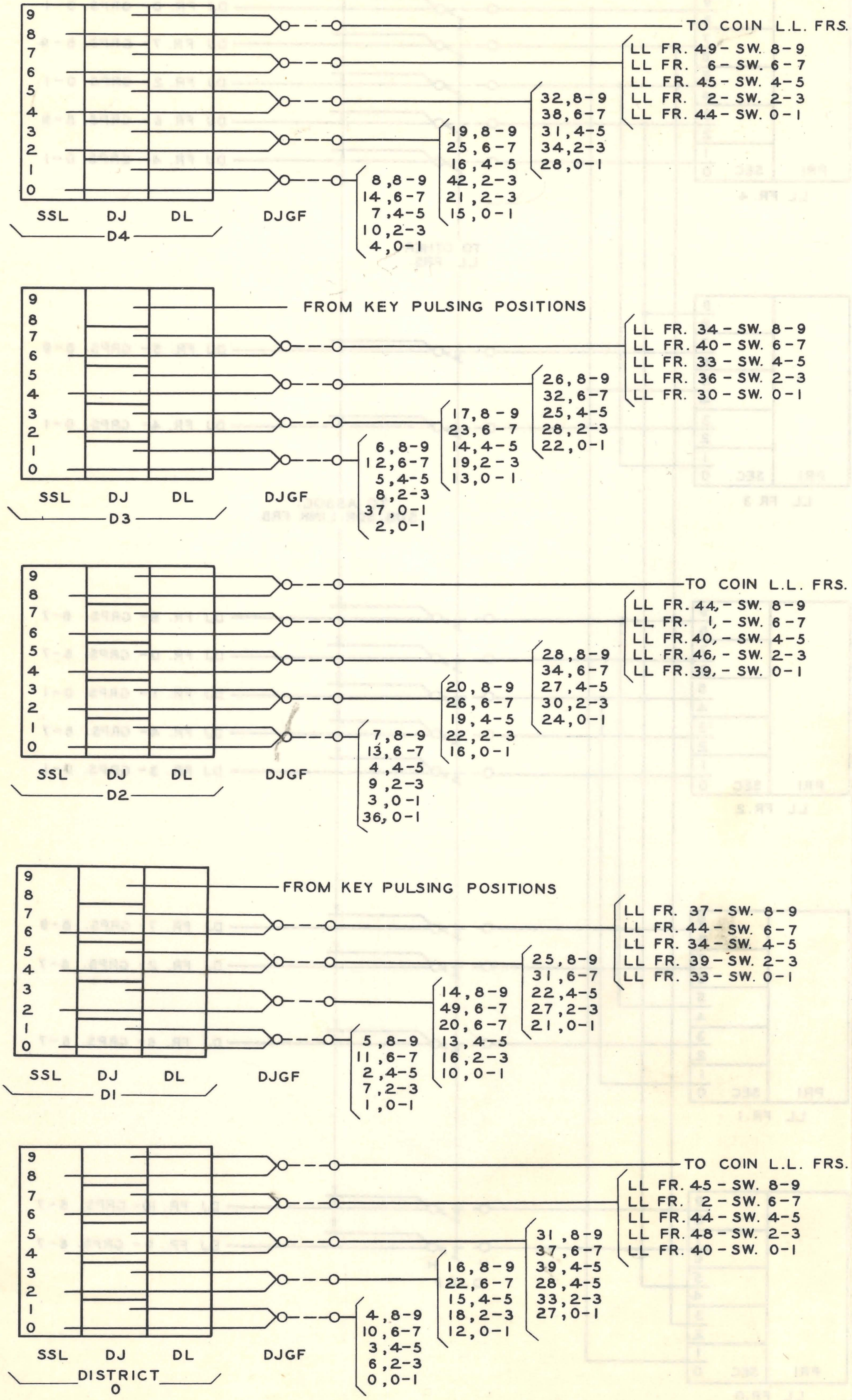

9
8
7
6
5
4
3
2
1
0
SSL
DJ
DL
D4
DJGF
TO COIN L.L. FRS.
LL FR. 49 - SW. 8-9
LL FR. 6 - SW. 6-7
LL FR. 45 - SW. 4-5
LL FR. 2 - SW. 2-3
LL FR. 44 - SW. 0-1
32,8-9
38,6-7
31,4-5
34,2-3
28,0-1
19,8-9
25,6-7
16,4-5
42,2-3
21,2-3
15,0-1
8,8-9
14,6-7
7,4-5
10,2-3
4,0-1
FROM KEY PULSING POSITIONS
LL FR. 34 - SW. 8-9
LL FR. 40 - SW. 6-7
LL FR. 33 - SW. 4-5
LL FR. 36 - SW. 2-3
LL FR. 30 - SW. 0-1
26,8-9
32,6-7
25,4-5
28,2-3
22,0-1
17,8-9
23,6-7
14,4-5
19,2-3
13,0-1
6,8-9
12,6-7
5,4-5
8,2-3
37,0-1
2,0-1
D3
TO COIN L.L. FRS.
LL FR. 44, - SW. 8-9
LL FR. 1, - SW. 6-7
LL FR. 40, - SW. 4-5
LL FR. 46, - SW. 2-3
LL FR. 39, - SW. 0-1
28,8-9
34,6-7
27,4-5
30,2-3
24,0-1
20,8-9
26,6-7
19,4-5
22,2-3
16,0-1
7,8-9
13,6-7
4,4-5
9,2-3
3,0-1
36,0-1
D2
FROM KEY PULSING POSITIONS
LL FR. 37 - SW. 8-9
LL FR. 44 - SW. 6-7
LL FR. 34 - SW. 4-5
LL FR. 39 - SW. 2-3
LL FR. 33 - SW. 0-1
25,8-9
31,6-7
22,4-5
27,2-3
21,0-1
14,8-9
49,6-7
20,6-7
13,4-5
16,2-3
10,0-1
5,8-9
11,6-7
2,4-5
7,2-3
1,0-1
D1
TO COIN L.L. FRS.
LL FR. 45 - SW. 8-9
LL FR. 2 - SW. 6-7
LL FR. 44 - SW. 4-5
LL FR. 48 - SW. 2-3
LL FR. 40 - SW. 0-1
31,8-9
37,6-7
39,4-5
28,4-5
33,2-3
27,0-1
16,8-9
22,6-7
15,4-5
18,2-3
12,0-1
4,8-9
10,6-7
3,4-5
6,2-3
0,0-1
DISTRICT 0

Fig. 2 - Typical Distribution of District Junctors.

CHAPTER 6 - SUBSCRIBER SENDER LINK, DISTRICT JUNCTOR, AND DISTRICT LINK FRAMES - ZONE REGISTRATION

The district group of frames which includes the district junctor, district link, and subscriber sender link frames was illustrated in a previous chapter. The district junctor frame is mounted in the center of the group with the subscriber sender link on the left and the district link frame on the right. The district junctor frame mounts the equipment required for 100 district junctors. The subscriber sender link frame provides access for these district junctors to subscriber senders and the district link frame access to office junctors. The primary bays of the two link frames on which district junctors appear are located immediately adjacent to the district junctor frame. The three frames are shipped as separate units and are located together on the floor in order to facilitate the wiring between them.

DISTRICT JUNCTOR FRAME

The district junctor frame illustrated on Fig. 1 provides for 100 district junctors in five separate units of twenty circuits each. Each unit of twenty district junctors is shipped separately and mounted on the frame in the field. Each unit is provided with an individual jack panel and fuse panel and has terminal strips to facilitate wiring to the subscriber sender link and district link frames adjacent and cabling to other frames in the office. When the district junctors on a unit are arranged to time local calls a timing device is located on each unit. Each district junctor unit mounts district junctors providing the same class of service but units serving varying classes of service are located on the same frame. This arrangement of units is due to the desirability of spreading the district junctors providing a particular class of service over as many frames as possible. Key pulsing district junctor units when required are located at the top of the frame. Coin, message rate, individual and 2 party, and flat rate district junctor units may be located on the same frame.

The district junctor corresponds to the cord circuit of the manual system or the district selector of the panel system. It furnishes talking battery to the calling subscriber. It maintains supervision over the call after the sender and marker have been dismissed and controls the disconnecting of the various paths at the end of the conversation. Message rate district junctors operate the line message register of the calling subscriber if the called party answers and coin district junctors, in conjunction with coin control circuits, collect or refund coins depending on whether or not the called party answers. Either message rate or coin district junctors, in conjunction with a local timing device located on the district junctor unit, will charge the subscriber an additional time for each overtime period on overtime calls. Non-coin district junctors may be arranged in conjunction with zone registration equipment to make additional charges on zone calls.

MESSAGE RATE DISTRICT JUNCTORS

Message rate district junctors are arranged to operate the line message register associated with the calling subscriber line as soon as the called party has answered. This is done by applying battery through a resistance over the "M" lead back through the line link to the register connected to the subscriber line. For 2 party message rate lines, two "M" leads are provided and 2 party message rate district junctors are arranged to differentiate between the "M" leads of the "tip" and "ring" parties under control of the originating marker and to operate the message register of the proper calling party.

Timing of overtime local calls may be furnished on either message rate individual or message rate 2 party district junctor units. In this case the timing device illustrated on Fig. 2 operates to time overtime calls in five minute (or as determined by local rate conditions) intervals and operates the line message register once for the initial and once for each additional period. The timing device consists of a drive shaft driven by a telechron motor and a series of timing units, one for each district junctor on a unit, which are connected to the shaft by means of individual clutches at the beginning of each timing period.

ZONE REGISTRATION

Zone registration refers to the multiple operation of the subscriber line register when calls are made into a restricted metropolitan zone. Non-coin (both individual and 2 party) district junctors may be arranged for zone registration. Subscribers served by this type of district junctor may make calls within a certain zone with a single charge while to other zones their line message register may be operated a number of times. Zone registration equipment mounted on frames separate from the district junctor frame is required for this type of service. This equipment includes timing interrupters for timing zone calls and means for connecting the district junctors to zone registration equipment and control circuits. This includes the zone registration timing interrupter frame (RTI), zone registration district connector frame (RDC) and the zone registration control frame (RC).

The timing interrupter unit consists of a motor-driven timer and relays used for pulsing 209 type selectors of five associated zone registration circuits. The five selectors and their contact protection are mounted with the equipment for one timing interrupter on a unit requiring the space of four mounting plates. Access to the zone registration circuit is obtained through a conventional 200 point, 4 wire, crossbar switch known as the district connector switch, located on the district connector frame. This frame accommodates twelve 200 point crossbar switches which act as a link between the district junctor and the timing equipment. The verticals of each switch are cabled to twenty district junctors, while the horizontals which are strapped to twenty verticals, are connected to zone registration circuits giving each district junctor access to a maximum of ten zone registration circuits. The horizontals of two or more switches may be multipled to provide as many district junctors as the timing devices can handle.

Testing for and allotting of an idle registration circuit available to a district junctor is accomplished by the zone registration control circuit under the direction of the district link and connector circuit and the originating marker. One control circuit is provided for each district junctor frame regardless of the number of junctors on the frame that are arranged for zone service. Each zone registration control circuit which is mounted on the zone registration control frame consists of three mounting plate spaces. The arrangement of zone registration equipment is illustrated on Fig. 3.

To insure that the zone registration circuits will be utilized as efficiently as possible, provision is made for multipling them on the district connector switches. This multipling may be furnished on either an interframe or intraframe basis. Interframe multipling consists of arranging the registration circuits in individual and common groups, the common group being accessible to district junctors of more than one frame, while the individual groups are accessible to district junctors on one frame. Intraframe multipling consists of arranging the registration circuits in individual and common groups made accessible only to the district junctors of a particular frame. The registration circuits in an individual group will be preferred and those of the common group will be used as overflow, being allotted only when the registration circuits in the individual group are busy.

COIN DISTRICT JUNCTORS

Coin district junctors are arranged to collect or refund a coin at the end of a conversation. To accomplish this they require the assistance of a coin control circuit. This circuit is selected through a coin control link frame at the end of a conversation and the coin control circuit collects or refunds the coin as directed by the district junctor. Local timing may be furnished on coin district junctor units and in this case, the coin control circuit is called in on the connection at the end of 4-1/2 minutes. The coin control circuit tests for and collects the deposited coin which serves as a signal to the calling subscriber that his call is due to terminate in 1/2 minute and then is disconnected. If he chooses to continue the conversation, he deposits an additional coin during the remaining 1/2 minute interval. At the end of the five minute period, a coin control circuit tests for the additional coin. If the coin has been deposited, the conversation then continues undisturbed for another 4-1/2 minute period. Should the subscriber fail to deposit a coin during the 1/2 minute interval, the coin control circuit will route the call to an operator for disposition.

KEY PULSING DISTRICT JUNCTORS

Key pulsing district junctors are furnished for the use of the DSA operator in setting up calls. These district junctors are furnished in a separate unit and only one is located on a given district junctor frame. This unit is not wired to the subscriber sender link frame since the district junctors do not require access to subscriber senders. Instead, they are cabled to the key pulsing sender link frame through which they obtain access to key pulsing senders. By means of her keyset the DSA operator is then able to set up the required number in a key pulsing sender. This sender obtains access to an originating marker and the marker controls the setting up of the call to an outgoing trunk in the usual way.

SUBSCRIBER SENDER LINK FRAME

The subscriber sender link frame located at the left of the district junctor frame is illustrated on Fig. 6. The 100 district junctors in addition to appearing on the horizontals of primary switches on the district link frame, also appear on the verticals of primary switches on the subscriber sender link frame for access to subscriber senders. The subscriber sender link frame is also arranged with five local cable arms of sufficient length to permit them to be soldered to the district junctor unit terminal strips after the frames are placed adjacent to each other on the floor.

PRIMARY AND SECONDARY SWITCH ARRANGEMENT

The right-hand or primary bay mounts ten 200 point 4 wire crossbar switches and the left-hand or secondary bay five 200 point 4 wire switches. Since there are eight leads per district junctor to be connected to senders, each district junctor appears on two verticals of primary switches. The arrangement of the sender links is shown on Fig. 5. Since there are 100 horizontals on the primary switches and two horizontals must be used for each sender link, there is a capacity for only fifty links. However, since the holding time of sender links is considerably less than 1/2 of that of district junctors, the ratio of fifty links to 100 district junctors, is satisfactory. In the secondary bays the sender links require 100 verticals which are found on five 200 point switches. The arrangement shown on Fig. 5 provides access to 100 senders which is more than the average number required for an office. The senders are divided into ten sub-groups, two of which appear on each secondary switch, the horizontals of secondary switches being strapped in such a manner as to divide each switch into four sections of five verticals each. The two groups of four leads each required for each sender are connected to the horizontal strapping of alternate sets of verticals on the same switch. This method of strapping facilitates varying the number of sub-groups by the addition of horizontal strapping when there are less than 100 senders. (By making the strapping continuous on each half of the switch, there would be only one sub-group per switch instead of two.) Each district junctor is connected to a vertical on two primary switches. The links of these pairs of primary switches are distributed to verticals in the alternate sections on the secondary switches.

SUBSCRIBER SENDER LINK CONTROLLER

The subscriber sender link frame is provided with a controller whose function it is to choose an idle sender and to notify the line link frame as to which district junctor group has clear access through the sender links to an idle sender.

Each group of ten district junctors has access to ten sender links. It is obvious that one of a group of district junctors which does not have access through idle sender links to an idle sender should not be chosen to handle the call. The line link indicates to the subscriber sender link control circuit in which group of ten district junctors it can place a call and if this group has at least two idle district junctors with an idle sender link to idle senders, the line link frame will be signalled to use the chosen group. The sender link controller chooses a sender group in which there are idle senders and which has an idle sender link to the group of district junctors in question. The choice of a particular district junctor and of a particular sender in their respective groups is controlled by the location of the calling line in its group of ten. This is an arbitrary method of choosing a particular district and sender and its purpose is to insure the use of the various circuits in rotation.

EMERGENCY SUBSCRIBER SENDER CONTROLLER

An emergency controller is provided to which the sender link can be connected by means of manual switches when the normal controller fails. Four switches are provided on each sender link frame, two of which represent the normal controller. These two switches should be restored to normal before the pair of switches representing the emergency controller are operated to allow the frame to operate on an emergency basis.

CLASS OF SERVICE AND FRAME INDICATION

Ten multicontact relays are furnished on each sender link frame, one for each sender group, whose function it is to connect the control leads from the line link frame to the sender which has been chosen. These include the class of service leads from the line link frame which are connected direct to the sender and which operate the proper class of service relay in the sender. In addition, a frame number indication is given through the connector relay to the sender so that the marker may be able to recognize which district frame group contains the calling district junctor.

SENDER MULTIPLE

Subscriber senders are cabled to the subscriber sender link frame secondary switches in groups of ten and the switchboard cable from the sender frames is connected first to a different link frame for each group of ten senders. The effect of this method of cabling is to minimize the effect on the sender link frames of any damage occurring to the sender multiple on any one sender link frame.

Two general plans are followed in laying out the multiple of senders. The multiple may be arranged in groups of 100 or less senders or in groups of over 100 senders. Where the number of senders is less than 100, groups of ten senders are cabled to as many secondary switches as possible on each sender link frame. Since the number of senders is seldom a multiple of ten, the odd number of senders is assigned to the last switch on a frame. The above practice is modified by requiring that the senders shall be divided into at least three sub-groups and that at least five senders shall appear on each secondary switch. Unequipped sender sub-groups are then cabled to equipped sub-groups on the same frame so that all links may reach senders.

Where the number of senders exceeds 100, each sender sub-group is multipled through as many link frames as required to provide, as far as possible, an equivalent number of appearances for each sender sub-group.

DISTRICT LINK FRAME

The district link frame located immediately to the right of the district junctor frame is illustrated on Fig. 4. The district junctors appear on the horizontals of the primary switches of the district link frame and for this reason the district link frame has five local cable arms, one for each district junctor unit which are of a sufficient length to be wired to the terminal strips on the district junctor units after the frames are in place on the floor. These local cable arms carry the district junctors to their locations on the district link primary switches.

PRIMARY AND SECONDARY SWITCH ARRANGEMENT

Two hundred point 3 wire switches are used for both primary and secondary switches on the district link frame. As stated previously, 100 district junctors appear on the horizontals of ten primary switches and are multipled across twenty verticals. Two hundred district links are wired to the verticals of the primary switches. The secondary switches employ split horizontals, each switch having ten left verticals and ten right verticals. The district links appear on the 200 secondary horizontals thus provided. The distribution of district links is indicated on Fig. 5.

In the distribution of district links from the primary switches, each primary switch is treated as though it were two half switches, a left half and a right half. Each primary left half switch has one district link to each of the ten secondary left half switches and each right half primary switch one to each of the ten secondary right half switches. Since a district link appears on a vertical of a primary half switch and on a horizontal of a secondary half switch any link may be traced in accordance with the following formula. The primary vertical is the same as the secondary half switch on which it appears and the primary switch is the same as the secondary horizontal.

The arrangement of district links just described, provides a symmetrical distribution of the 200 links from the primary switches to the secondary half switches. This symmetry of distribution simplifies wiring and maintenance tracing of paths and, as will be discussed later, is satisfactory from a traffic point of view.

Two hundred office junctors are outgoing from the secondary switches of the district link frame. As we shall see later, these junctors are divided into groups of equal size, one group to each office frame and are matched with the 200 district links as required to set up combinations of paths between district junctors and outgoing trunks.

DISTRICT LINK CONNECTOR CIRCUIT

The connector circuit of the district link frame consists of marker connector, link connector, and junctor connector relays. The marker connector relays consist of 1-1/2 multicontact relays per marker which are for the purpose of connecting the test leads of district links and office junctors to the marker, together with the operating leads for the various crossbar switches. The link connector circuit consists of ten multicontact relays, each of which connects the test leads of twenty district links (from a particular primary switch) to the particular marker connector relay' for connection to the marker. The junctor connector circuit consists of twenty multicontact relays, each of which controls the test leads for a maximum of twenty office junctors. The operation of one of these relays connects the test leads of a maximum of twenty office junctors to the marker connector relay being used for setting up the call.

Since the number of office junctors from each district link frame to a particular office link frame depends on the total number of office link frames, the number of junctors to each office link frame varies from ten in the case of twenty office frames to 100 when there are only two office frames. Since the marker tests office junctors in groups of twenty, there may be a number of junctor connector relays associated with the group of office junctors to a given office link frame when there are less than ten frames. For this reason the various junctor connector relays associated with the group to a given office frame may be used alternately to connect first, second, third, fourth, and even fifth sub-groups of test leads to the marker.

The assignment of the junctor sleeve leads to the junctor connector relays depends on the distribution pattern used for distributing the office junctors from district link to office link frames. Since this distribution will be discussed in the next chapter the method of assigning office junctor sleeve leads to the junctor connector relays on the district link frame will also be discussed later.

MARKER MULTIPLE

There is a set of marker connector relays for each originating marker having access to a particular district link frame. The test leads from each set of multicontact relays are carried to the particular marker in switchboard cable and are also multipled to the corresponding multicontact relay on other district link frames. In order to safeguard this multiple in case of damage to a particular district link frame, the even numbered markers are cabled to the lowest numbered district link frame and multipled to all higher numbered frames. The odd numbered markers are cabled to the highest numbered district link frame and multipled to all lower numbered frames.

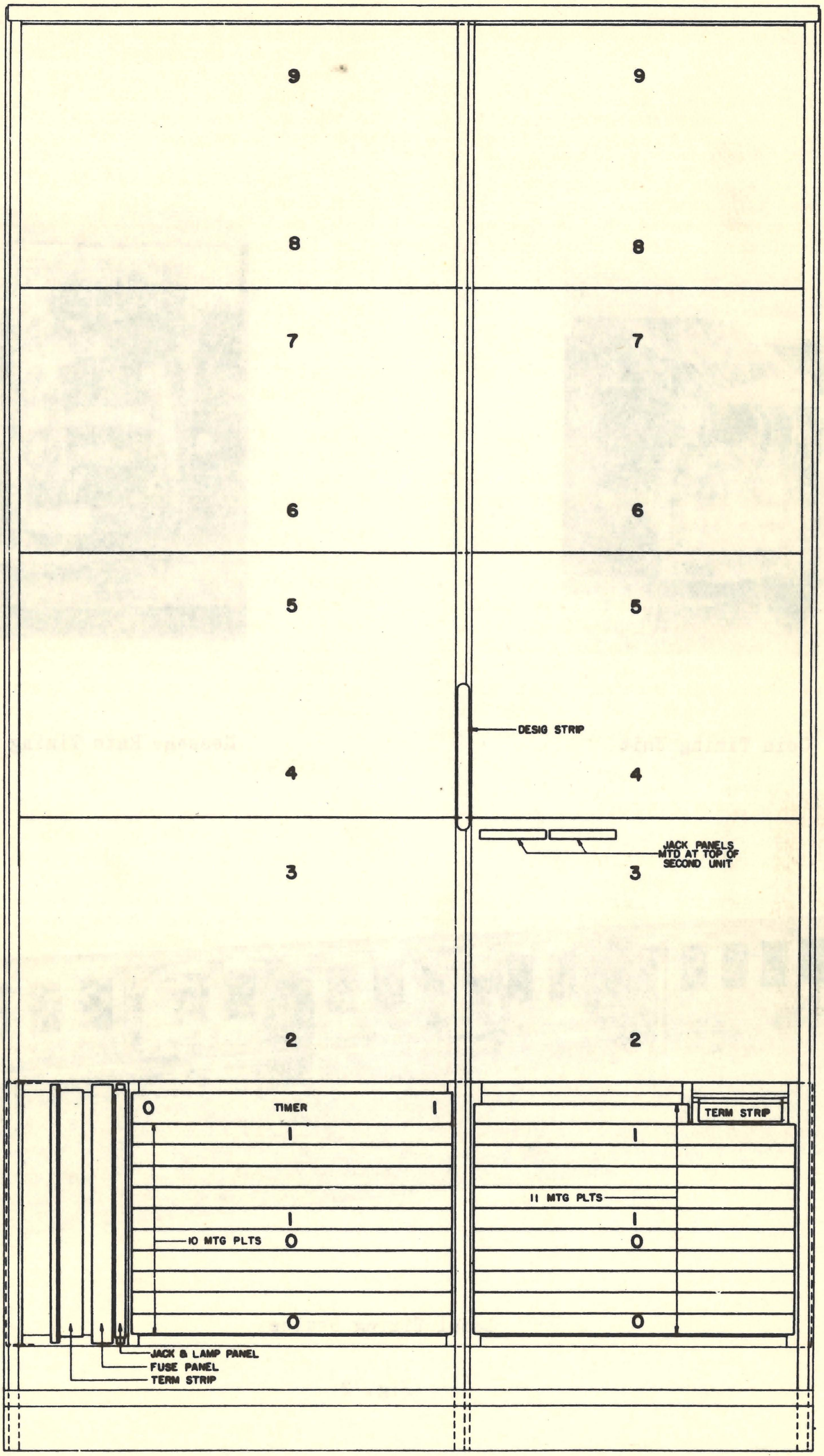
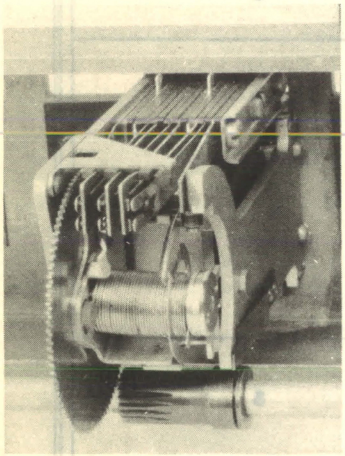
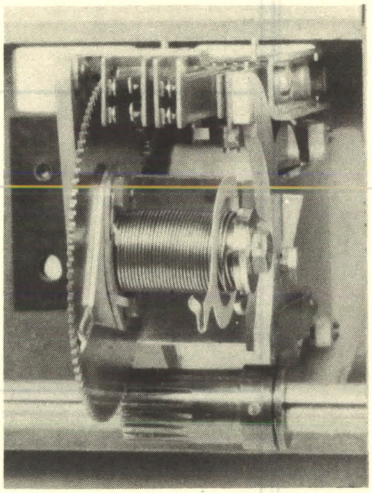

9
9
8
8
7
7
6
6
5
5
DESIG STRIP
4
4
JACK PANELS MTD AT TOP OF SECOND UNIT
3
3
2
2
0
TIMER
1
TERM STRIP
1
1
11 MTG PLTS
1
1
10 MTG PLTS
0
0
0
0
JACK & LAMP PANEL
FUSE PANEL
TERM STRIP

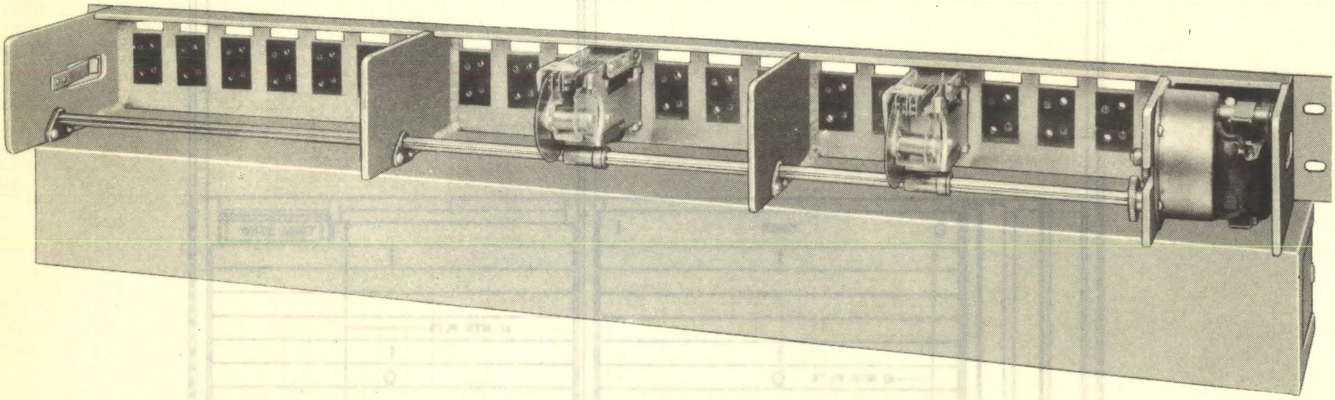
Fig. 1 - District Junctor Frame



Coin Timing Unit



Message Rate Timing Unit



Local Timing Device

Fig. 2

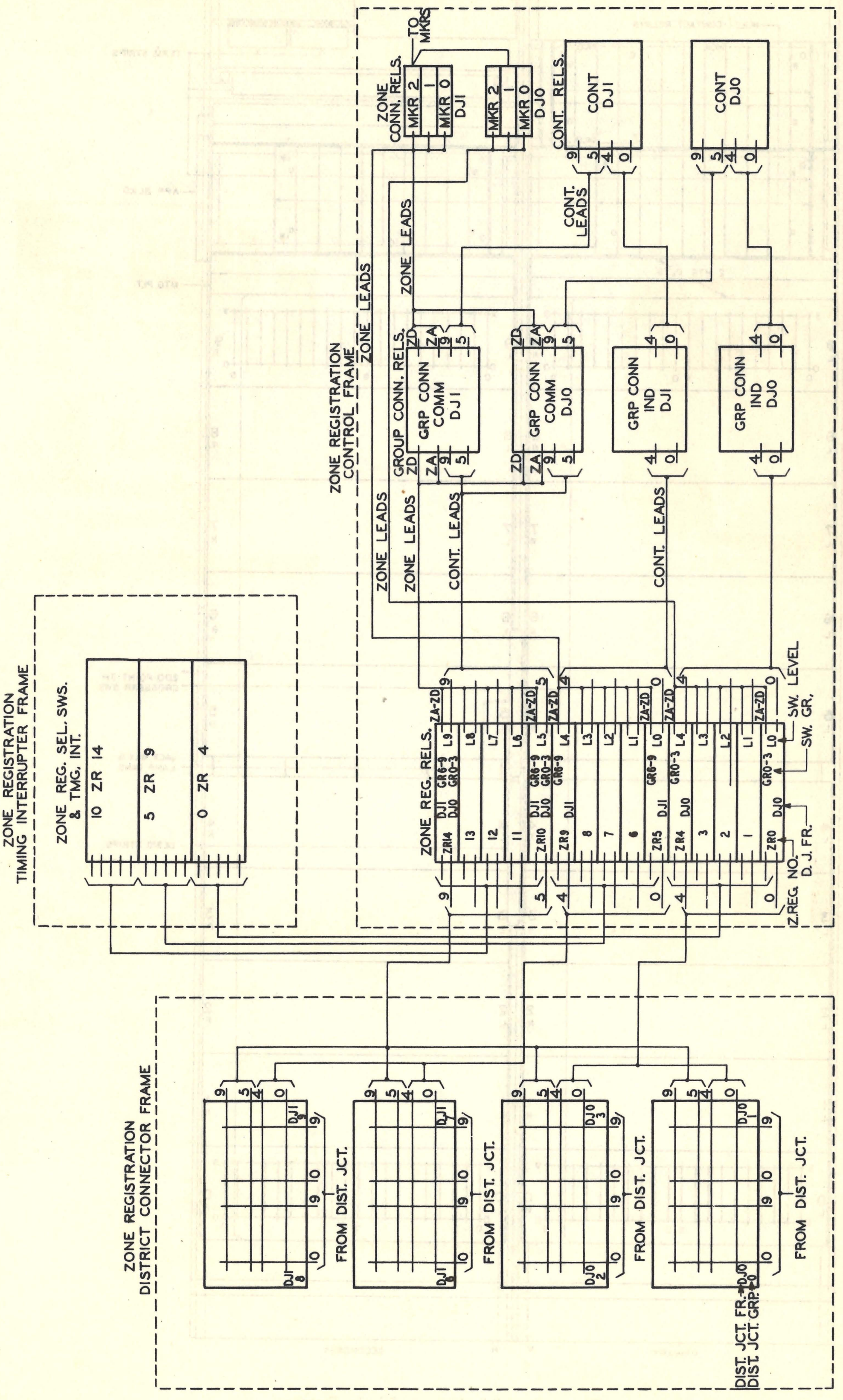

ZONE REGISTRATION TIMING INTERRUPTER FRAME
ZONE REG. SEL. SWS. & TMG. INT.
10 ZR 14
5 ZR 9
0 ZR 4
ZONE REGISTRATION CONTROL FRAME
ZONE CONN. RELS.
MKR 2
1
MKR 0
DJ1
TO MKRS
DJ0
CONT. RELS.
CONT DJ1
CONT DJ0
CONT. LEADS
ZONE LEADS
GROUP CONN. RELS.
GRP CONN COMM DJ1
GRP CONN COMM DJ0
GRP CONN IND DJ1
GRP CONN IND DJ0
ZD
ZA
9
5
4
0
ZONE REG. RELS.
ZR14
DJ1 DJ0
GR6-9 GR0-3
L9
ZA-ZD
ZR10
ZR9
ZR5
ZR4
ZR0
L0
Z.REG. NO.
D.J. FR.
SW. GR.
SW. LEVEL
ZONE REGISTRATION DISTRICT CONNECTOR FRAME
DJ1 9
DJ1 8
DJ1 7
DJ1 6
DJ0 3
DJ0 2
DJ0 1
DJ0 0
10
19
FROM DIST. JCT.
DIST. JCT. FR.-DJ0
DIST. JCT. GRP.-0

Fig. 3 - Zone Registration Schematic of Connections

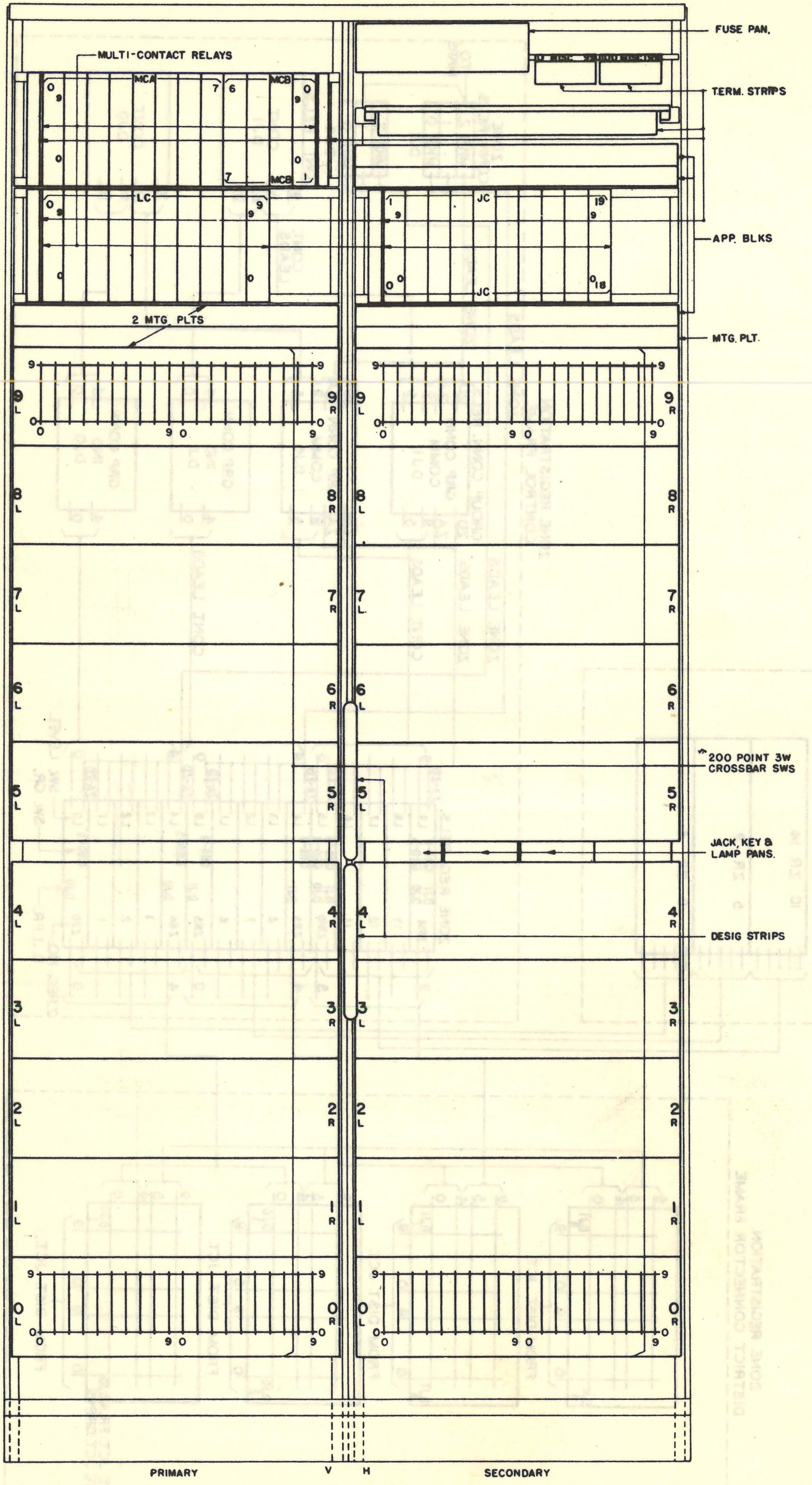

FUSE PAN.
TERM. STRIPS
MULTI-CONTACT RELAYS
MCA
MCB
LC
JC
APP. BLKS
2 MTG. PLTS
MTG. PLT.
9 L
9 R
8 L
8 R
7 L
7 R
6 L
6 R
5 L
5 R
4 L
4 R
3 L
3 R
2 L
2 R
1 L
1 R
0 L
0 R
200 POINT 3W CROSSBAR SWS
JACK, KEY & LAMP PANS.
DESIG STRIPS
PRIMARY
V
H
SECONDARY

Fig. 4 - District Link Frame

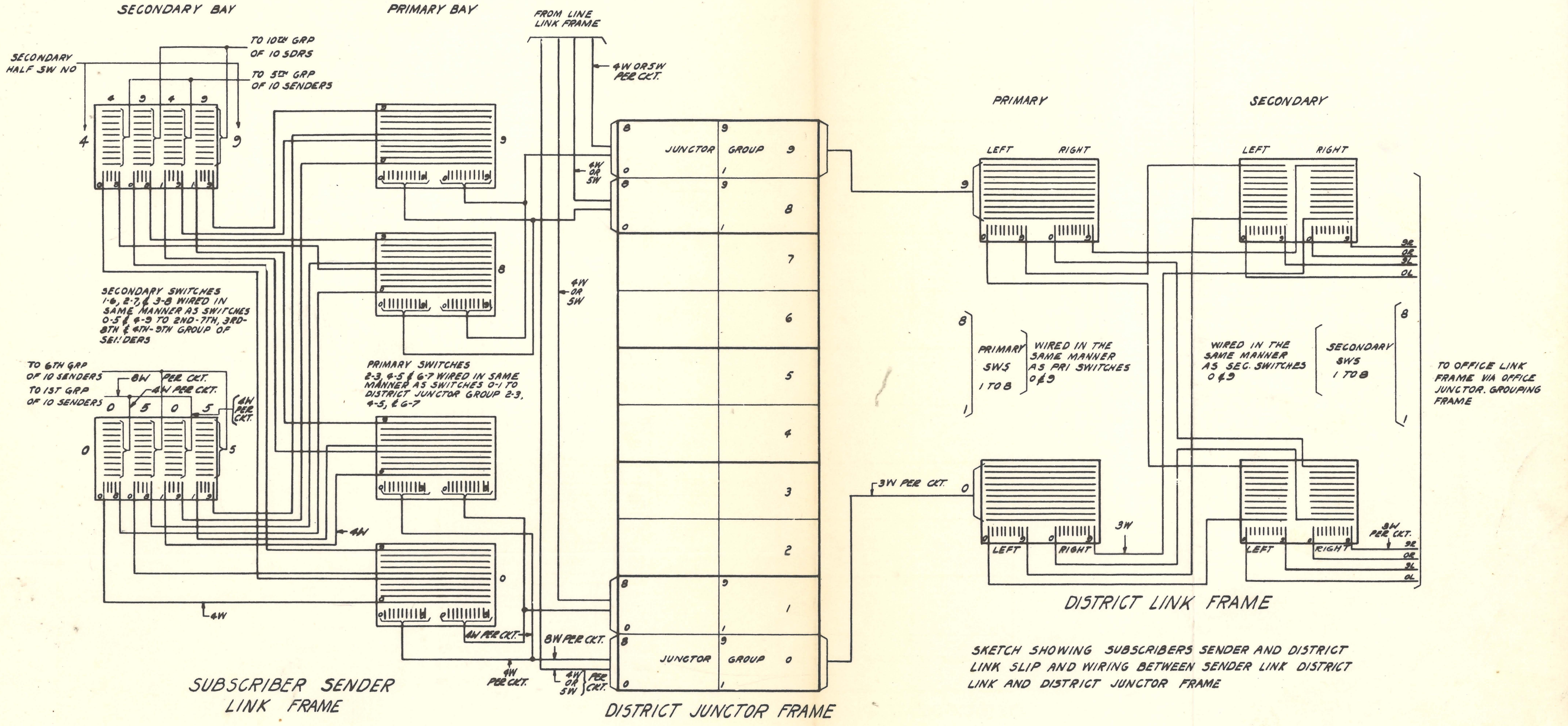

SECONDARY BAY
PRIMARY BAY
FROM LINE LINK FRAME
SECONDARY HALF SW NO
TO 10TH GRP OF 10 SDRS
TO 5TH GRP OF 10 SENDERS
4W OR 5W PER CKT.
4W OR 5W
SECONDARY SWITCHES 1-6, 2-7, & 3-8 WIRED IN SAME MANNER AS SWITCHES 0-5 & 4-9 TO 2ND-7TH, 3RD-8TH & 4TH-9TH GROUP OF SENDERS
TO 6TH GRP OF 10 SENDERS
TO 1ST GRP OF 10 SENDERS
8W PER CKT.
4W PER CKT.
4W PER CKT.
PRIMARY SWITCHES 2-3, 4-5 & 6-7 WIRED IN SAME MANNER AS SWITCHES 0-1 TO DISTRICT JUNCTOR GROUP 2-3, 4-5, & 6-7
4W
4W
4W PER CKT.
8W PER CKT.
4W PER CKT.
4W OR 5W
PER CKT.
JUNCTOR GROUP
JUNCTOR GROUP
SUBSCRIBER SENDER LINK FRAME
DISTRICT JUNCTOR FRAME
PRIMARY
SECONDARY
LEFT
RIGHT
LEFT
RIGHT
PRIMARY SWS 1 TO 8
WIRED IN THE SAME MANNER AS PRI SWITCHES 0 & 9
WIRED IN THE SAME MANNER AS SEC. SWITCHES 0 & 9
SECONDARY SWS 1 TO 8
TO OFFICE LINK FRAME VIA OFFICE JUNCTOR. GROUPING FRAME
3W PER CKT.
3W
8W PER CKT.
9R
0R
9L
0L
DISTRICT LINK FRAME
SKETCH SHOWING SUBSCRIBERS SENDER AND DISTRICT LINK SLIP AND WIRING BETWEEN SENDER LINK DISTRICT LINK AND DISTRICT JUNCTOR FRAME

Fig. 5 - Schematic of District Frame Group

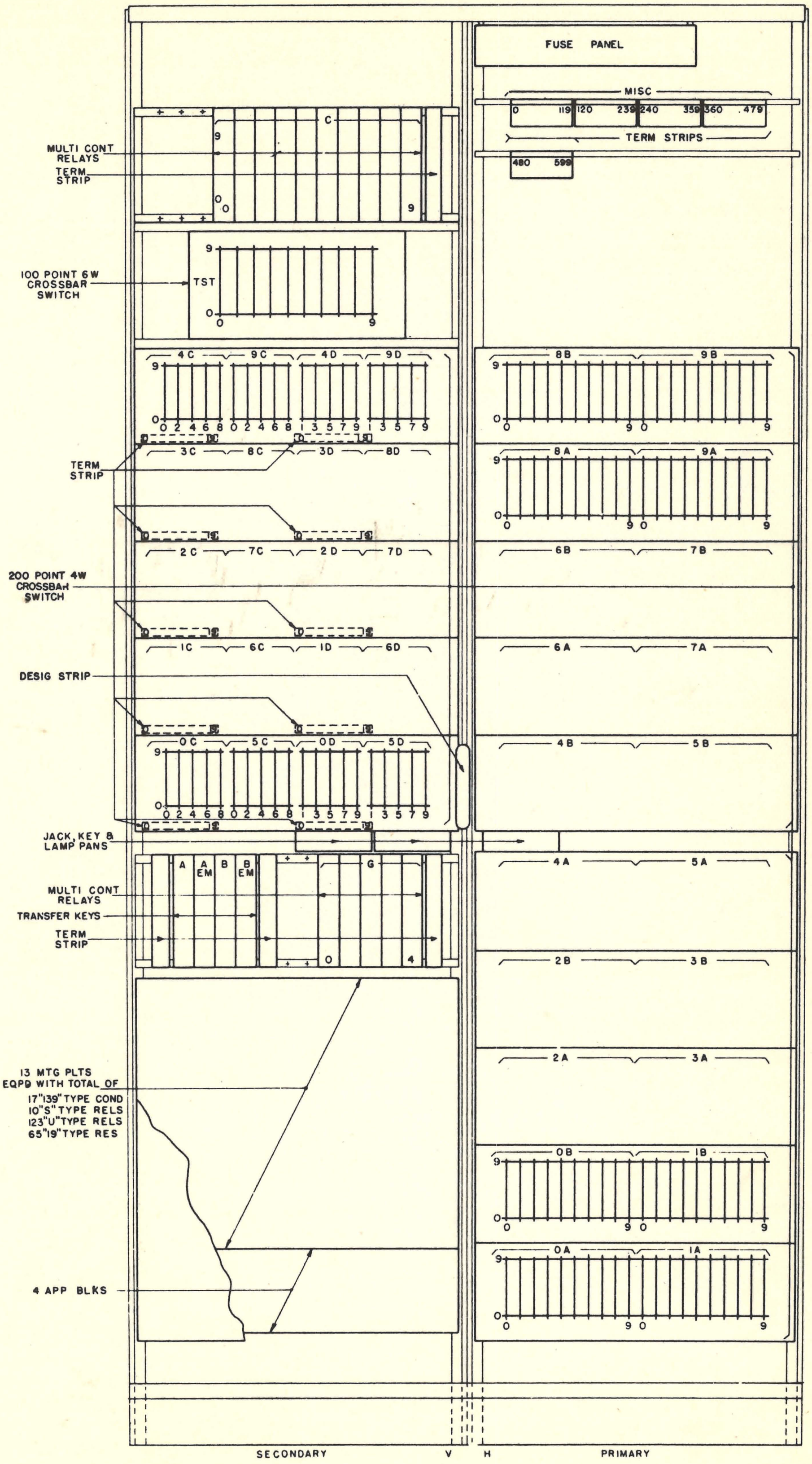

FUSE PANEL
MISC
0
119
120
239
240
359
360
.479
TERM STRIPS
480
599
C
MULTI CONT RELAYS
TERM STRIP
100 POINT 6W CROSSBAR SWITCH
TST
4C
9C
4D
9D
3C
8C
3D
8D
2C
7C
2D
7D
1C
6C
1D
6D
0C
5C
0D
5D
8B
9B
8A
9A
6B
7B
6A
7A
4B
5B
4A
5A
2B
3B
2A
3A
0B
1B
0A
1A
TERM STRIP
200 POINT 4W CROSSBAR SWITCH
DESIG STRIP
JACK, KEY & LAMP PANS
MULTI CONT RELAYS
TRANSFER KEYS
TERM STRIP
A
A EM
B
B EM
G
13 MTG PLTS EQPD WITH TOTAL OF
17"139" TYPE COND
10"S" TYPE RELS
123"U" TYPE RELS
65"19" TYPE RES
4 APP BLKS
SECONDARY
V
H
PRIMARY

Fig. 6 - Subscriber Sender Link Frame

CHAPTER 7 - OFFICE LINK FRAME - OFFICE JUNCTOR DISTRIBUTION

The district link and office link frames together offer the means of connecting a district junctor, on which a call is waiting, to an outgoing trunk to the called office. The district link frame offers the district junctor a path to 200 office junctors, the junctors being divided into as many groups as there are office link frames, each group to an office link frame containing an equal number of junctors. The office link in effect offers the outgoing trunk, preselected by the marker, a path to 200 office junctors and in this case the office link frame has a group of junctors from each district link frame. The effect of this arrangement is of two primary-secondary combinations facing each other with the originating marker the agency for matching the paths between district junctor and outgoing trunk. The office link frame also gives the originating marker access to the test leads of outgoing trunks for the purpose of selecting an idle trunk to be used on a given call.

OFFICE LINK FRAME

The office link frame is illustrated on Fig. 1. Ten primary switches are mounted on the left-hand bay and ten secondary switches on the right. The outgoing trunks appear on the horizontals of secondary switches, with the trunks in a group to a given destination assigned alternately to the secondary switches of a pair of office link frames. The office junctors from district link frames appear on the verticals of primary switches. Like the district link frame the arrangement of both primary and secondary switches gives the effect of four 100 point switches instead of two 200 point switches since the left and right halves of each primary and secondary switch are treated as units in spreading the office links. The two halves of each primary switch are treated as units in the distribution of office junctors from the district link secondary switches.

OFFICE LINK SPREAD

As with the district links on the district link frame the spread of office links between primary and secondary switches is the same on each office link frame and the same regardless of the number of office link frames. There are 200 office links between primary and secondary switches so that there are two office links from each primary switch to each secondary switch or one link from each primary half switch to each secondary half switch. Fig. 2 illustrates this spread. The horizontal number on the primary switch on which a particular link appears is the same as the secondary switch number to which the link is taken. The primary half switch number on which a given link appears is the same as the vertical number on the secondary switch to which the link is wired.

ASSIGNMENT OF OUTGOING TRUNKS

The capacity of an office link frame is 200 outgoing trunks if the secondary horizontals are split, 100 if non-split. Intermediate capacities of 120, 140, 160, or 180 may be obtained by splitting the 0-1, 0-3, 0-5, or 0-7 horizontal levels of each secondary switch respectively.

The originating marker is arranged to make a simultaneous test of a maximum of forty outgoing trunks in an attempt to locate an idle one. A group to a given destination containing more than forty trunks is sub-grouped into test groups (forty trunks). The forty trunks of a test group are distributed over the secondary switches of the two office link frames of a pair. A feature of the marker permits trunks to more than one destination to be placed in the same test group. On a given call, all trunks to other than the desired destination are disregarded. A test group normally includes all of the trunks to a given destination which are assigned to one pair of office link frames, although trunks to a given destination may be assigned to more than one test group on more than one pair of office link frames.

Fig. 3 shows the method of assigning the outgoing trunks to test groups. The forty trunks are spread over the twenty secondary switches of the two office link frames, two per switch, in order to insure uninterrupted service in case of frame or switch trouble. A test group of trunks, whether the horizontals or "levels" are split or non-split, is assigned to an even level and the next higher odd-numbered level of each of the secondary switches of each frame of a pair. When the horizontals are not split two horizontals or "trunk levels" are required per switch for each test group. When the multiple is split the other half of each level is assigned to another test group. Fig. 3 shows the assignment for two test groups of outgoing trunks. The numbers assigned to the outgoing trunks indicate the order of their presentation to the marker for testing. The first test group is connected through the (TL-0) and (TR-1) relays (trunk connector relays) of both frames. Tracing the assignment for the various trunks of the group the order of assignment is as follows:

Even-Numbered Trunks (On Even Frame)

Trunk	0	2	4	6	8	10	12	14	16	18
Switch	0L	1R	2L	3R	4L	5R	6L	7R	8L	9R
Level	0	1	0	1	0	1	0	1	0	1

Trunk	20	22	24	26	28	30	32	34	36	38
Switch	0R	1L	2R	3L	4R	5L	6R	7L	8R	9L
Level	1	0	1	0	1	0	1	0	1	0

Odd-Numbered Trunks (On Odd Frame)

Trunk	1	3	5	7	9	11	13	15	17	19
Switch	0L	1R	2L	3R	4L	5R	6L	7R	8L	9R
Level	0	1	0	1	0	1	0	1	0	1

Trunk	21	23	25	27	29	31	33	35	37	39
Switch	0R	1L	2R	3L	4R	5L	6R	7L	8R	9L
Level	1	0	1	0	1	0	1	0	1	0

Similarly, the second test group may be traced through the contacts of the (TL-1) and (TR-0) relays on the two frames. To give the marker access to the test leads for the first test group, the (TL-0) and (TR-1) relays of both office link frames are operated. For the second test group the (TL-1) and (TR-0) relays will be operated although if the levels were not split these relays would not be required. The trunk connector relays (see Fig. 1) may be furnished as required for split or non-split horizontals.

OFFICE LINK EXTENSION FRAME

Fig. 1 also indicates the equipment arrangement for an office extension frame. This frame provides extension secondary switches whose verticals are multipled to the corresponding verticals of the regular secondary switches. When extension is used, the horizontals of the regular secondary switches are not split and the horizontals of extension secondary switches are never split. With this arrangement, the office links have access to 100 trunks through the regular secondary switches and 100 through the extension secondary switches.

When split horizontals are used on the regular secondary switches the number of office links having access to a given outgoing trunk is cut in half and the number of available paths between the district junctor and the outgoing trunk is correspondingly decreased. Where the number of office junctors per district per office is less than twenty (more than ten frames) this becomes severe. In general, therefore, split secondary horizontals will not be employed for more than ten frames. Where the capacity of an office link frame (for more than ten frames) must be more than 100 trunks, extension frames will, in general, be employed.

Trunks are assigned to office extension frames in pairs by the same method previously discussed except that split levels are not used.

OFFICE LINK CONNECTOR CIRCUIT

The office link connector circuit consists of marker connector relays, link connector relays, and trunk connector relays. Two multicontact relays are required per marker to connect the test leads from each office link frame to the marker. Ten multicontact relays are furnished as link connector relays, each relay connecting the test leads for twenty office links to the marker connector relays these being the office links having access to one secondary switch. The trunk connector relays function as described above to connect the test leads for a test group of outgoing trunks to the marker connector relays. Each trunk connector relay consists of one half of a multicontact relay two relays being operated on each office link frame of a pair to connect the test group of outgoing trunks to the marker.

OFFICE JUNCTOR DISTRIBUTION

The distribution of district links and office links between primary and secondary switches on their respective frames follows a definite pattern which does not vary from one frame to the next and the wiring for this distribution can, therefore, be included in a frame local cable in a uniform manner for all district frames and for all office frames. The distribution of office junctors is more complex in that the number of junctors from a given district to a given office frame varies with the number of frames. When there are ten district and ten office frames the number of office junctors per district per office is twenty. When there are twenty district and twenty office frames, the number of office junctors per district per office is only ten. The number of junctors per district per office also varies with other numbers of frames. The general problem then is to arrange the distribution of office junctors in such a manner that calls will proceed with a minimum of blocking and at the same time permit the number of frames to grow (and the number of office junctors per district per office to decrease) with a minimum of wiring changes. Before discussing the method of obtaining this distribution, however, the relation of district links and office links to office junctors in forming "channels" should be examined.

ARRANGEMENT OF CHANNELS

The originating marker is arranged to test a maximum of twenty channels simultaneously, each channel consisting of a district link, office junctor, and an office link. The marker obtains access to the test leads for these paths through a link connector relay and a junctor connector relay on the district link frame and a link connector relay on the office link frame, respectively. Each of these relays provides a maximum of twenty test leads. Where the number of district and office frames is ten, there will actually be twenty office junctors which can be used for a given call although with other numbers of frames there may be either more or less than this number of office junctors available. The following discussion assumes ten district link and ten office link frames where twenty office junctors are actually available for use between a given district link frame and a given office link frame since the distribution for this combination of frames is the simplest.

Twenty district links appear on the verticals of the primary switch on which a calling district junctor is located. These twenty district links are distributed one from each half switch to the twenty secondary half switches on the district link frame. Since each of these district links (on a call to a particular office link frame) may be matched with an office junctor there is one office junctor to the particular office link frame from each district link secondary half switch.

The outgoing trunk chosen by the marker to handle a call is located on a horizontal of a secondary switch on an office link frame. Twenty office links appear on the verticals of this secondary switch, one from each primary half switch. In order to match one office junctor with each of these twenty office links, one office junctor from the particular district frame terminates on a vertical of each primary half switch on the office link frame. Actually, each office junctor from a given secondary half switch on a particular district link frame terminates on a similarly numbered primary half switch on the office link frame.

The twenty district links from the primary switches on which the calling district junctor appears are numbered 0L, 1L, etc. to 9L and 0R, 1R, etc. to 9R in accordance with the vertical and primary half switch on which they appear. Each district link appears on a secondary half switch having the same number. The office junctors are similarly numbered in accordance with the district link secondary half switch and office link primary half switch on which they appear. The office link from an office link primary half switch (0L, 1L and etc. to 9L and 0R, 1R and etc. to 9R) goes to a similarly numbered vertical on a secondary switch and each office link is, therefore, correspondingly numbered.

In matching the district links, office junctors, and office links, three paths having the same number are always used together on a call from a particular district to a particular office. An 0L district link, 0L office junctor, and 0L office link are always used together and are connected to the same channel test relay which also bears the number 0L. The 0L district link may, however, be used with some other office junctor on a call to another office frame and the 0L office link may be used with some other office junctor on a call from some other district frame.

ASSIGNMENT OF CALLS

The channel test relays are operated by any one of the three paths of a combination which may be busy. The originating marker tests for an idle channel in the twenty channels under test in order from lowest to highest. This results in the assignment of calls to lower numbered channels first and leaves the higher numbered channels available for calls in busy periods. This method of assigning calls is sometimes referred to as "packing" and is advantageous from a traffic and maintenance point of view. The assignment of calls proceeds in an orderly manner from the lower to the higher numbered channels. Leaving the higher numbered channels open reduces the blocking of calls and insures a call finding a combination of paths to the office frame required in all but the very busiest periods. To insure that the point of greatest wear may be varied during the life of the office the point at which testing starts may be changed from the lowest to some other point in the chain at stated intervals.

10-10 DISTRIBUTION

The office junctor distribution for ten district link and ten office link frames on which the previous discussion was based is illustrated on Fig. 4. There are twenty office junctors per district per office, one from each secondary half switch on the district link to a correspondingly numbered primary half switch on each office link frame. Fig. 4 shows the twenty office junctors between district link frame 2 and office link frame 7 for the 10-10 case. On this sketch the twenty possible channels between the calling district junctor and the outgoing trunk may be traced. In this case each junctor connector relay on the district link frame provides access to twenty junctors, and all terminals on each junctor connector relay are assigned to usable paths. The distribution of the twenty junctors between other district link frames and other office link frames is similar.

20-20 DISTRIBUTION

With twenty districts and twenty office frames there are only ten office junctors per district per office. In this case the ten office junctors from a given district link frame to a given office link frame are assigned to only ten of the secondary half switches on the district link frame and the correspondingly numbered half switches on the office link frame. These ten are scattered over the twenty half switches available in accordance with a definite pattern which provides a minimum of blocking. The junctor connector relays can now connect the test leads for only ten usable office junctors to the marker for a given call. The marker tests these leads in groups of twenty, however, and the junctors not available or "blanks" are made artificially busy by "pattern" relays in the marker.

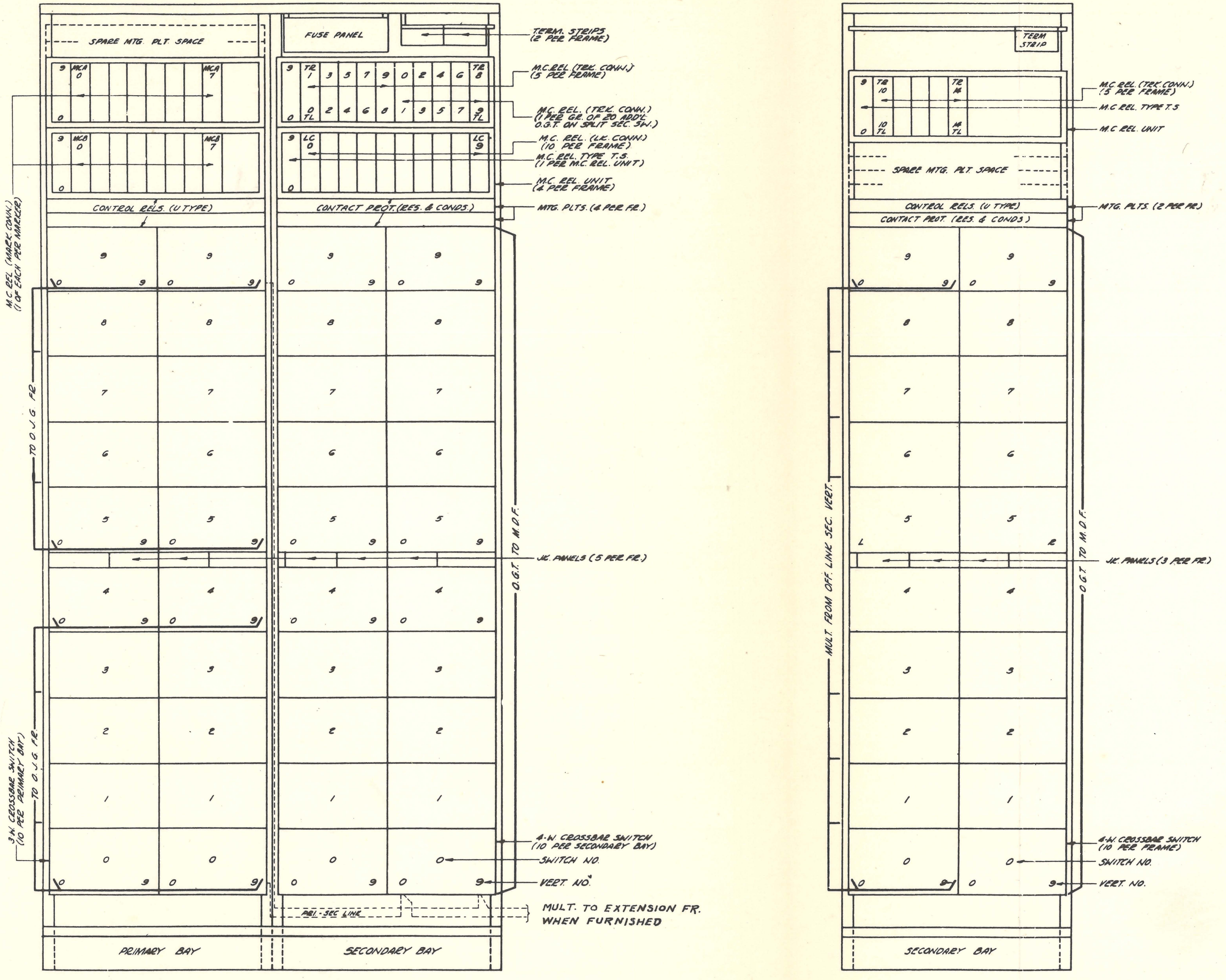
METHODS OF DISTRIBUTION FOR VARYING NUMBERS OF FRAMES

The twenty district and twenty office frame combination is assumed to be the maximum size of an installation. However, it will be desirable in most cases to start with a smaller number of frames than this. As the office grows, the number of office junctors per district per office will decrease and junctors will have to be run from the old frames to the new ones. The change in the number of junctors presents a considerable wiring problem.

This problem can be made easier by arranging part of the wiring so that it need never be changed as the office grows. When the maximum (twenty frames) is reached there still will be ten office junctors per district per office and these junctors are, therefore, cabled permanently between frames and remain fixed regardless of the size of the office. The test leads for these fixed junctors are wired permanently to the contacts of the junctor connector relays from the switches. The variable junctors (those required in excess of ten per district per office) are connected between frames with temporary wiring and the junctor test leads are connected to the junctor connector relays with temporary wiring at the district link frame terminal strips.

OFFICE JUNCTOR GROUPING FRAME

Fig. 5 illustrates the principle of the office junctor grouping frame. This grouping frame is arranged to facilitate the distribution of office junctors from district link to office link frames. The frame consists of terminal strips arranged in horizontal and vertical rows for the termination of office junctor leads from the district and office frames. Each vertical row of terminal strips terminates the office junctor leads for two district link frames requiring a total of ten vertical rows for the maximum of twenty district link frames. There must be ten terminal strips in each vertical row since the leads for twenty junctors are dropped off on each terminal strip. Each horizontal row of terminal strips terminates the office junctor leads for two office link frames requiring a total of ten horizontal rows with the maximum of twenty office link frames. For the equipped district link and office link frames, therefore, ten office junctors per district per office are connected permanently between frames. The vertical rows representing unequipped district link frames have no leads from district link frames. The horizontal rows representing unequipped office link frames have no leads from office link frames. The number of office junctors per district per office may be made greater than ten (for less than twenty frames) by jumpering between the district link terminal strips and office link terminal strips on which there is no permanent wiring between frames connected. When an installation reaches the maximum of twenty frames, all jumpers disappear and ten office junctors per district per office are connected permanently for all frames.


SPARE MTG. PLT. SPACE
FUSE PANEL
TERM. STRIPS (2 PER FRAME)
MCA 0
MCA 7
MCB 0
MCB 7
M.C.REL. (TRK. CONN.) (5 PER FRAME)
M.C. REL. (TRK. CONN.) (1 PER GR. OF 20 ADD'L O.G.T. ON SPLIT SEC. SW.)
M.C. REL. (LK. CONN.) (10 PER FRAME)
M.C. REL. TYPE T.S. (1 PER M.C. REL. UNIT)
M.C. REL. UNIT (4 PER FRAME)
MTG. PLTS. (4 PER FR.)
CONTROL RELS. (U TYPE)
CONTACT PROT. (RES. & CONDS.)
M.C. REL. (MARK. CONN.) (1 OF EACH PER MARKER)
TO O.J.G. FR.
O.G.T. TO M.D.F.
JK. PANELS (5 PER FR.)
3-W. CROSSBAR SWITCH (10 PER PRIMARY BAY)
TO O.J.G. FR.
4-W. CROSSBAR SWITCH (10 PER SECONDARY BAY)
SWITCH NO.
VERT. NO.
PRI.-SEC. LINE
MULT. TO EXTENSION FR. WHEN FURNISHED
PRIMARY BAY
SECONDARY BAY
TERM STRIP
M.C. REL. (TRK. CONN.) (5 PER FRAME)
M.C. REL. TYPE T.S.
M.C. REL. UNIT
SPARE MTG. PLT. SPACE
CONTROL RELS. (U TYPE)
CONTACT PROT. (RES. & CONDS.)
MTG. PLTS. (2 PER FR.)
MULT. FROM OFF. LINK SEC. VERT.
O.G.T. TO M.D.F.
JK. PANELS (3 PER FR.)
4-W. CROSSBAR SWITCH (10 PER FRAME)
SWITCH NO.
VERT. NO.
SECONDARY BAY

OFFICE LINK FRAME

OFFICE LINK EXTENSION FRAME

Fig. 1 - Office Link And Office Link Extension Frames

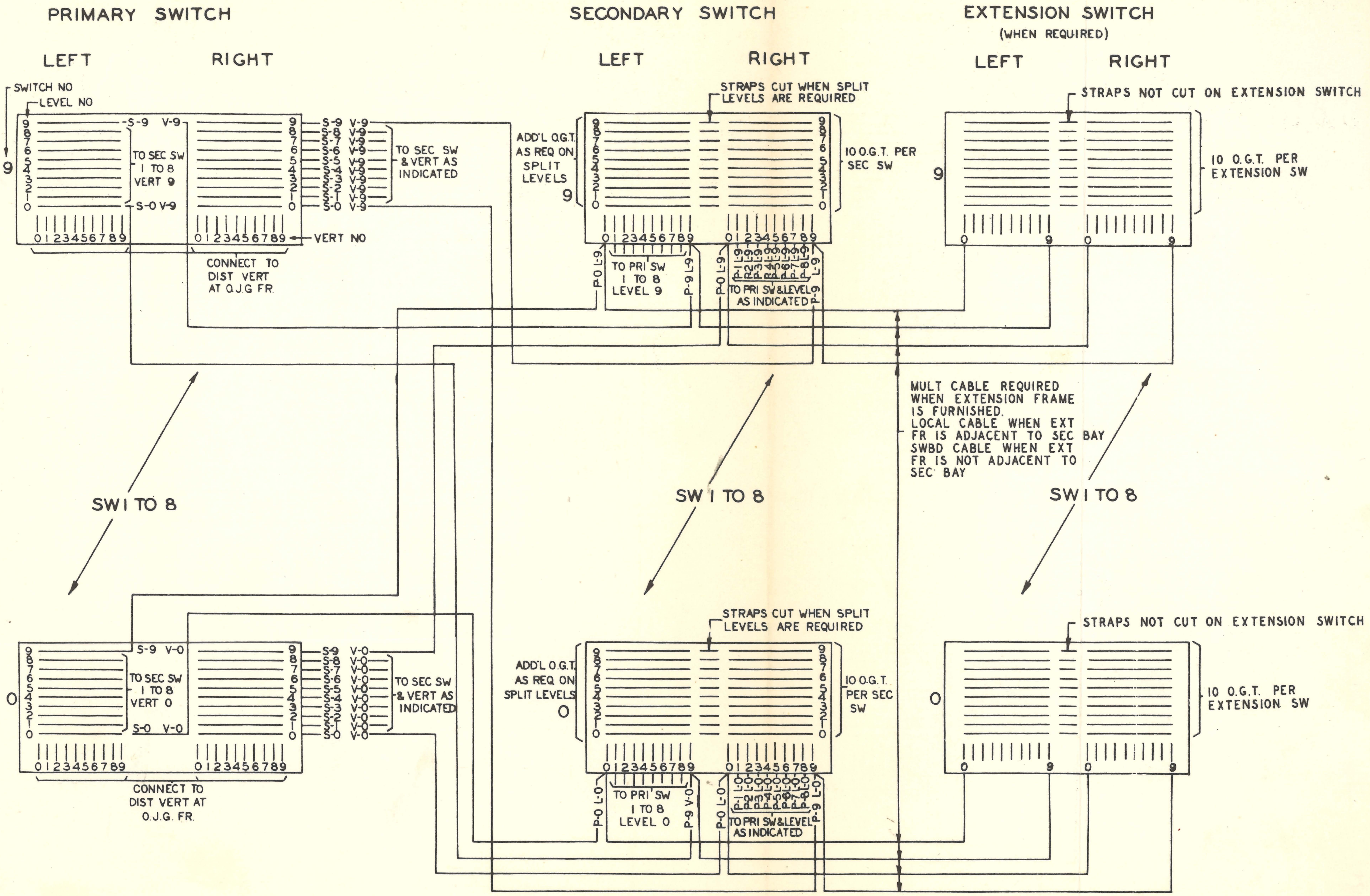
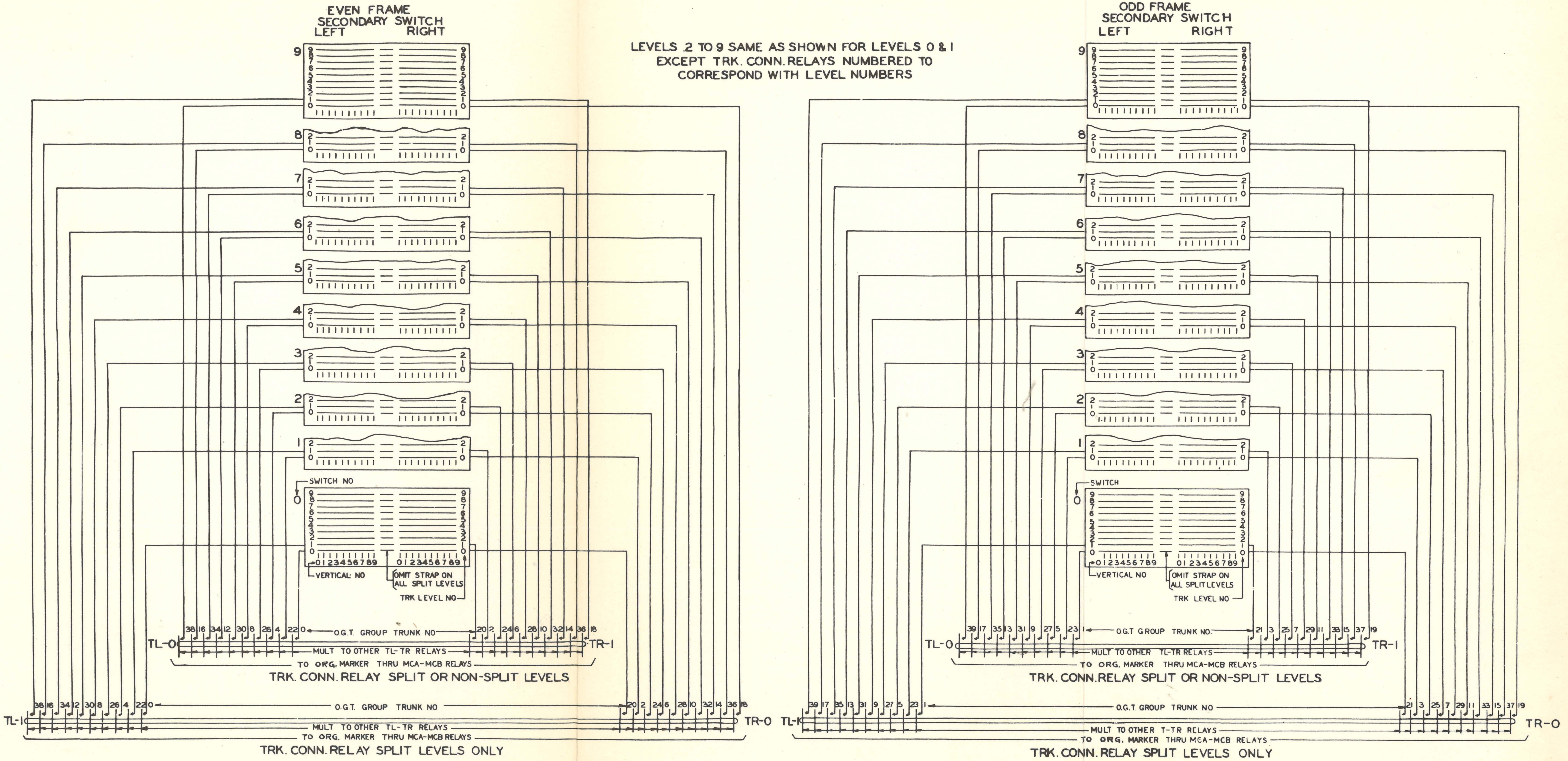

PRIMARY SWITCH
LEFT
RIGHT
SWITCH NO
LEVEL NO
S-9 V-9
TO SEC SW 1 TO 8 VERT 9
S-0 V-9
TO SEC SW & VERT AS INDICATED
VERT NO
CONNECT TO DIST VERT AT O.J.G FR.
SECONDARY SWITCH
STRAPS CUT WHEN SPLIT LEVELS ARE REQUIRED
ADD'L O.G.T. AS REQ ON SPLIT LEVELS
10 O.G.T. PER SEC SW
TO PRI SW 1 TO 8 LEVEL 9
P-0 L-9
P-9 L-9
TO PRI SW & LEVEL AS INDICATED
EXTENSION SWITCH
(WHEN REQUIRED)
STRAPS NOT CUT ON EXTENSION SWITCH
10 O.G.T. PER EXTENSION SW
MULT CABLE REQUIRED WHEN EXTENSION FRAME IS FURNISHED.
LOCAL CABLE WHEN EXT FR IS ADJACENT TO SEC BAY
SWBD CABLE WHEN EXT FR IS NOT ADJACENT TO SEC BAY
SW 1 TO 8
SW 1 TO 8
SW 1 TO 8
S-9 V-0
TO SEC SW 1 TO 8 VERT 0
S-0 V-0
TO SEC SW & VERT AS INDICATED
CONNECT TO DIST VERT AT O.J.G. FR.
STRAPS CUT WHEN SPLIT LEVELS ARE REQUIRED
ADD'L O.G.T. AS REQ ON SPLIT LEVELS
10 O.G.T. PER SEC SW
TO PRI SW 1 TO 8 LEVEL 0
P-0 L-0
P-9 V-0
TO PRI SW & LEVEL AS INDICATED
STRAPS NOT CUT ON EXTENSION SWITCH
10 O.G.T. PER EXTENSION SW

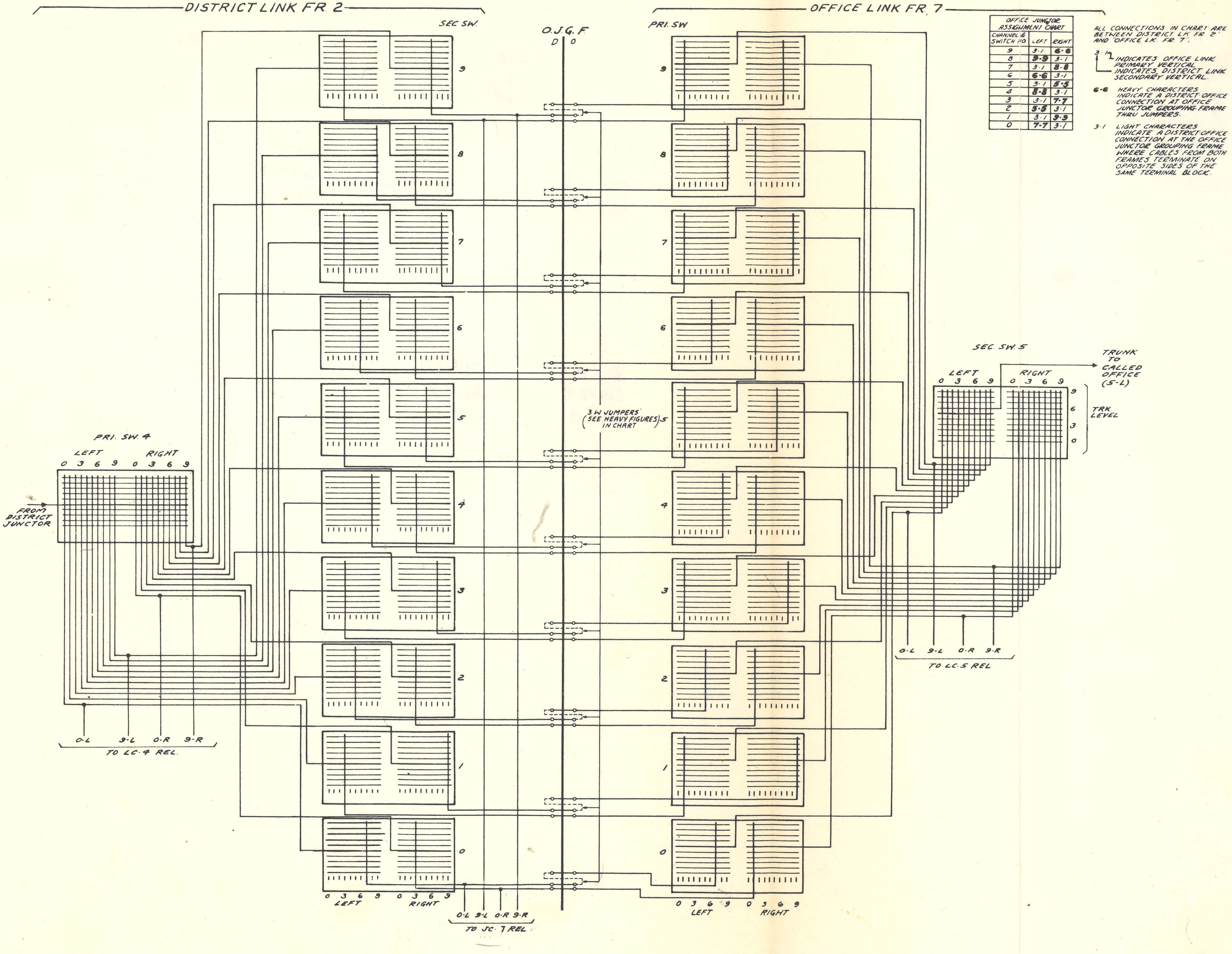
Fig. 2 - Primary-Secondary Office Link Spread And Connection to Link Extension Frame



LEVELS 2 TO 9 SAME AS SHOWN FOR LEVELS 0 & 1 EXCEPT TRK. CONN. RELAYS NUMBERED TO CORRESPOND WITH LEVEL NUMBERS

EVEN FRAME
SECONDARY SWITCH
LEFT
RIGHT
9
8
7
6
5
4
3
2
1
SWITCH NO
0
0 1 2 3 4 5 6 7 8 9
VERTICAL NO
OMIT STRAP ON ALL SPLIT LEVELS
TRK LEVEL NO
38 16 34 12 30 8 26 4 22 0
O.G.T. GROUP TRUNK NO
20 2 24 6 28 10 32 14 36 18
TL-0
TR-1
MULT TO OTHER TL-TR RELAYS
TO ORG. MARKER THRU MCA-MCB RELAYS
TRK. CONN. RELAY SPLIT OR NON-SPLIT LEVELS
TL-1
TR-0
TRK. CONN. RELAY SPLIT LEVELS ONLY
ODD FRAME
SECONDARY SWITCH
LEFT
RIGHT
SWITCH
39 17 35 13 31 9 27 5 23 1
O.G.T GROUP TRUNK NO.
21 3 25 7 29 11 33 15 37 19
TL-0
TR-1
MULT TO OTHER TL-TR RELAYS
TO ORG. MARKER THRU MCA-MCB RELAYS
TRK. CONN. RELAY SPLIT OR NON-SPLIT LEVELS
TL-1
TR-0
MULT TO OTHER T-TR RELAYS
TRK. CONN. RELAY SPLIT LEVELS ONLY

Fig. 3 - Office Link Frame - Method of Assigning Outgoing Trunks to Marker OGT Test Group At Secondary Switch and Trunk Connector Relays Split and Non-Split Levels


DISTRICT LINK FR 2
SEC SW.
O.J.G.F
D O
PRI. SW
OFFICE LINK FR 7
9
8
7
6
5
4
3
2
1
0
SEC. SW. 5
TRUNK TO CALLED OFFICE (5-L)
LEFT
RIGHT
0 3 6 9 0 3 6 9
TRK LEVEL
3 W JUMPERS (SEE HEAVY FIGURES) IN CHART
PRI. SW. 4
FROM DISTRICT JUNCTOR
O-L 9-L O-R 9-R
TO LC-4 REL.
TO JC-7 REL
TO LC-5 REL

OFFICE JUNCTOR ASSIGNMENT CHART		
CHANNEL & SWITCH NO.	LEFT	RIGHT
9	3-1	**6-6**
8	**9-9**	3-1
7	3-1	**8-8**
6	**6-6**	3-1
5	3-1	**5-5**
4	**8-8**	3-1
3	3-1	**7-7**
2	**5-5**	3-1
1	3-1	**9-9**
0	**7-7**	3-1

ALL CONNECTIONS IN CHART ARE BETWEEN "DISTRICT LK FR 2" AND "OFFICE LK. FR. 7".

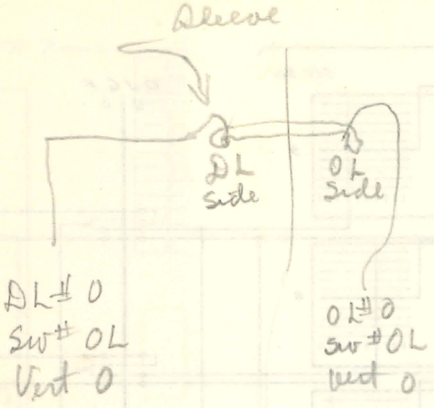
3-1: 3 INDICATES OFFICE LINK PRIMARY VERTICAL; 1 INDICATES DISTRICT LINK SECONDARY VERTICAL.

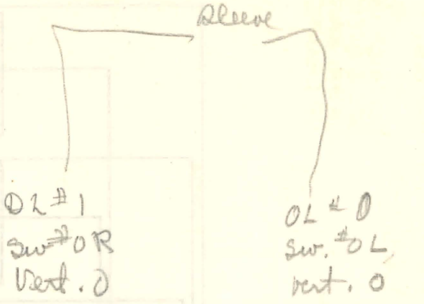
6-6 HEAVY CHARACTERS INDICATE A DISTRICT-OFFICE CONNECTION AT OFFICE JUNCTOR GROUPING FRAME THRU JUMPERS.

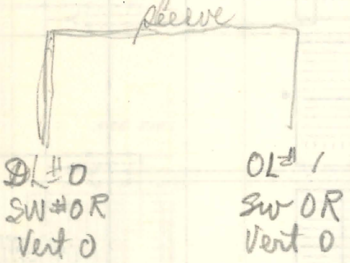
3-1 LIGHT CHARACTERS INDICATE A DISTRICT-OFFICE CONNECTION AT THE OFFICE JUNCTOR GROUPING FRAME WHERE CABLES FROM BOTH FRAMES TERMINATE ON OPPOSITE SIDES OF THE SAME TERMINAL BLOCK.

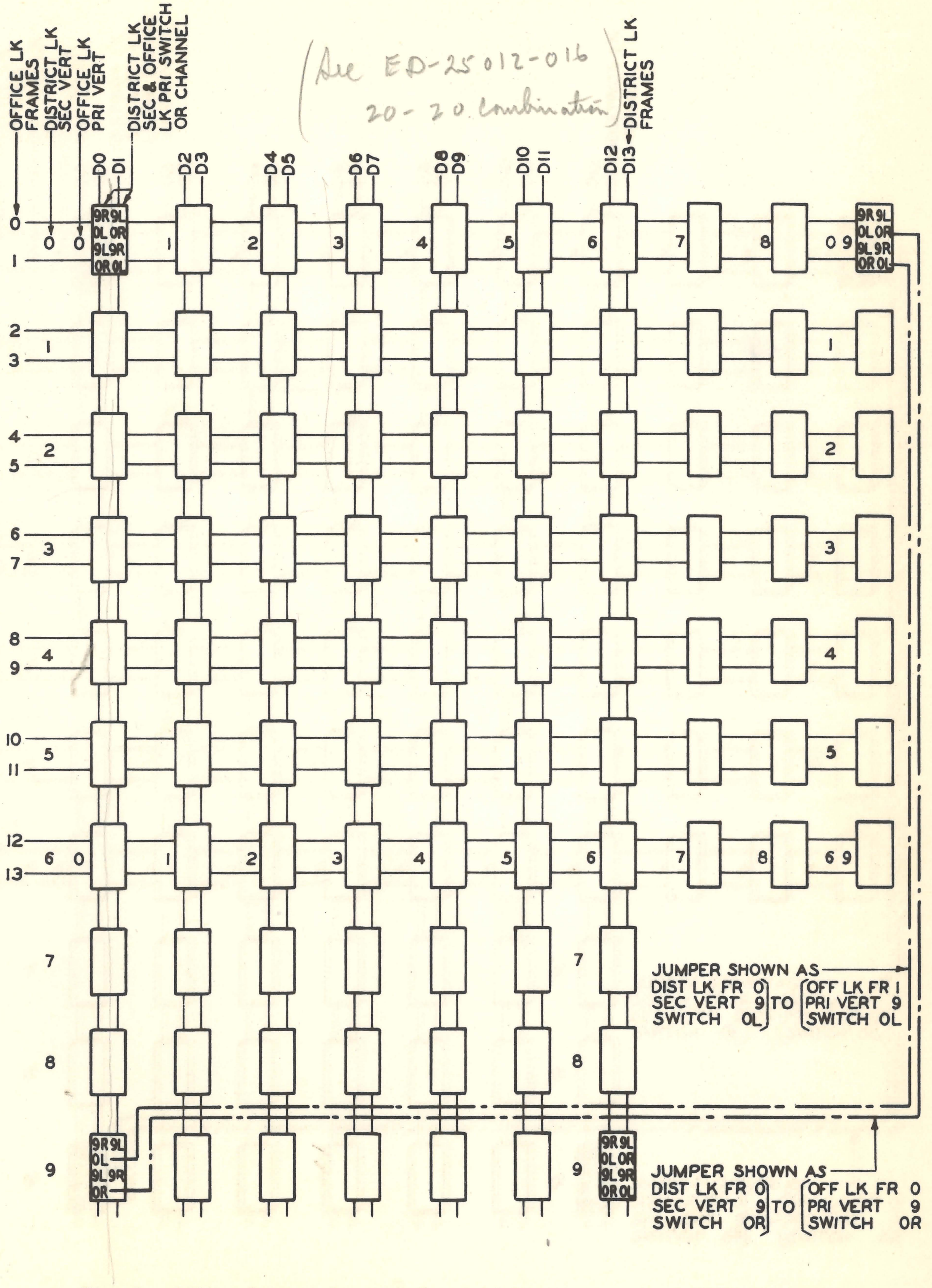
Fig. 4 - Office Junctor Schematic Showing Channels (Or Paths) Between A District Junctor On Primary Switch 4 District Frame 2 And An OGT On Secondary Switch 5 Office Frame 7 When There Are 10 District and 10 Office Frames

ES-25012-016


Sleeve
DL Side
OL Side
DL # 0
SW # OL
Vert 0
OL # 0
sw # OL
vert 0


Sleeve
DL # 1
SW # OR
Vert. 0
OL # 0
sw. # OL
vert. 0


Sleeve
DL # 0
SW # OR
Vert 0
OL # 1
SW OR
Vert 0


OFFICE LK FRAMES
DISTRICT LK SEC VERT
OFFICE LK PRI VERT
DISTRICT LK SEC & OFFICE LK PRI SWITCH OR CHANNEL
DISTRICT LK FRAMES
D0 D1
D2 D3
D4 D5
D6 D7
D8 D9
D10 D11
D12 D13
0
1
2
3
4
5
6
7
8
9
10
11
12
13
9R 9L
0L 0R
9L 9R
0R 0L

(See ED-25012-016
20-20 combination)

JUMPER SHOWN AS
DIST LK FR 0 SEC VERT 9 SWITCH OL TO OFF LK FR 1 PRI VERT 9 SWITCH OL

JUMPER SHOWN AS
DIST LK FR 0 SEC VERT 9 SWITCH OR TO OFF LK FR 0 PRI VERT 9 SWITCH OR

Fig. 5 - Office Junctor Grouping Frame 14 District and 14 Office Frames Shown

CHAPTER 8 - ORIGINATING SENDER FRAME AND ORIGINATING MARKER CONNECTOR FRAME

The originating sender frame is arranged for five originating senders which may be subscriber senders or "A" operator senders of the key pulsing type. In general, the originating sender frame consists of all subscriber senders or all "A" operator key pulsing senders, however, a combination of the two may be used when desired. The subscriber and key pulsing senders are assembled, wired, and tested on a unit basis. The completed units are then mounted on the frame and the frame local cable connected before shipment. Since the subscriber and key pulsing sender are similar, the discussion in this chapter will be limited to the subscriber sender. The subscriber sender is used in completing calls from a dial subscriber while the key pulsing sender is used by the key pulsing "A" operator.

A subscriber sender circuit consists of relays and a 100 point 6 wire crossbar switch as shown on Fig. 1. There are five of these senders mounted on one sender frame. Each sender is individually connected to a sender link frame by eight leads direct to the secondary switch and four leads connected to the sender selection portion of the sender link control circuit. In addition to these leads there are those which are common to a group of ten senders maximum which connect to the sender link control circuit for registering district frame indications and the class of service of the calling subscriber, together with four control leads. The subscriber senders may be divided into several groups of relays depending upon their function, as follows:

The general control circuit relays control the connection between the sender and the sender link and control circuit, between the sender and the originating marker, and between the sender and the district junctor.

The dial pulse and switchhook control circuit relays receive and count the dial pulses of each digit and provide switchhook supervision at all times except while the sender monitor is connected to the sender.

The office code and number dialed and the number of the district junctor frame involved are recorded upon the crossbar switch. There is one vertical assigned for the district frame, two verticals for the "A" digit and one vertical for each of the remaining digits in the number dialed. The digits are recorded on the horizontal crosspoints in each vertical as numbered from the bottom 0 to 9. Additional relays are required to record whether the district frame number is below or above ten, to record the class of service of the calling line and to steer the information to the proper vertical for each digit.

The selection register relays function with the originating marker to record the information which the sender requires in order to do its part in establishing the connection to the called line.

The fundamental circuit relays include those which are required for making fundamental selections, for recording reverse battery or overflow, and for making trunk guard test.

The counting relays are operated in successive pairs by the pulsing of the stepper relay which is energized by the revertive pulses generated by distant panel selectors or by the crossbar terminating sender. The number of pairs operated for particular selection is determined by the number of pulses required from the number dialed.

The selection sequence circuit relays control internal connections in the sender in a definite order as the sender progresses through its successive selections and trunk tests.

The PCI pulsing circuit relays are used to transmit the called number to a manual office in place of the sequence switch as used in panel.

The timing circuit measures off maximum allowed times for the calling subscriber to start dialing, to finish dialing, and for the sender to release. If these times are exceeded, the timing circuit directs the call to the sender monitor so that proper disposition may be made of the call.

There are several options which may be provided in the subscriber senders. All subscriber senders are arranged to handle flat rate, individual message rate, and "coin first" service. If 2 party message rate service is required, all senders in the group are wired for party test. This option adds only a few relays. If service is required for coin lines where dial tone may be obtained before the coin is deposited ("dial tone first" service) an additional feature is required to test for the deposited coin before the connection is established to the called subscriber. There is also an option whereby the sender either brings in a sender monitor, after a certain delay, in case trouble prevents the completion of the call or returns a tone to the subscriber and disconnects automatically if operators are not available in the building to monitor on senders which are in trouble.

CIRCUIT FUNCTIONS

The purpose of the subscriber sender circuit is to receive and record information given to it by the calling subscriber so that it can direct the switching mechanism to establish a connection to the called subscriber.

When the subscriber sender is seized by the sender link and control circuit it registers the class of service of the calling line and the number of the district link frame involved. The sender is arranged to accept as many as twelve different classes of service. The class of service relays are operated as determined by the cross-connections in the line link and the assignment of the subscriber line to the proper vertical file on the line link frame. The various classes of service which are frequently provided are coin and unrestricted, restricted and zone registration service for flat rate and message rate lines. Coin lines may require the deposit of the coin either before or after dial tone and may be semipublic, public or resident telephones with either single or multislots for receiving the coin. The district frame number is recorded on the "F" vertical of the crossbar switch and also on (F00) or (F10) relays depending upon whether the frame number is below or above ten.

When the class of service indicates that the calling subscriber is on a 2 party message rate line the sender makes party test. This test is made prior to the subscriber receiving dial tone. Party test is made only on calls from party lines since dial tone is delayed for the period of time required to make party test. This test consists of testing the tip and ring for a ground condition. If the call is from a tip party subscriber the line will be grounded.

Dial tone is sent to the subscriber as soon as the sender is connected to the calling line, or as soon as party test has been made if the call is from a party line. In case the subscriber does not dial, for any reason, or the call was originated by trouble on the line, the sender after a period of twenty to forty seconds will cause the call to be routed to a permanent signal operator for investigation. If the subscriber dials insufficient digits, it is called to the attention of the sender monitor for supervision.

The sender will receive and record the digits of the number dialed. In case zero is dialed as the first digit, only one digit need be dialed to complete the call to the special service operator. There are other operator calls, such as long distance, repair service, and commercial department calls, which require only three digits to be dialed. On full selector calls, the office code and four numerical digits are required to complete the call. On calls to manual offices, five numerical digits may be used including the station letter or numbers between 10,000 and 10,999 (see Fig. 3).

As soon as the office code is registered, the sender connects to an originating marker through an originating marker connector circuit. The sender transmits the office code, class of service, and number of district link frame to the marker.

The sender receives from the originating marker and registers all information which the sender requires to establish the connection in the called office. This information is very similar to that received by the sender from the decoder in the panel system except that the district and office selections in the local office are not included. This information includes the class of call, the compensating resistance required over any of the trunk loops, whether a panel office selector is used and, if so, the necessary selections required thereby. The sender then awaits an indication from the marker that the connection has been established to the trunk, after which it tests the outgoing trunk to determine if the trunk is normal.

For full selector calls to a panel office, the sender controls the incoming and final selectors, receives reverse battery from the incoming selector, closes the district junctor talking paths and then releases the subscriber sender link connection. On a call to a crossbar office, the sender transfers the called number to the terminating sender from which it receives reverse battery and disconnects as for a call to a panel office. In both these cases, the called number is sent out for incoming and final selections, being satisfied by revertive ground pulses. These pulses come from the terminating sender if the call is to a crossbar office.

If the call is to a manual office the sender waits until the trunk is assigned at the distant end and then sends call indicator pulses for the four numerical and station digits. The call is handled in a similar manner if it is routed through a manual or mechanical tandem except that call indicator pulses are also sent for the code dialed.

When the call is of an operator class, the sender disconnects upon completion of trunk test, no further selections being required.

If the originating marker encounters trouble in decoding or establishing a connection to the outgoing trunk, or if the terminating panel or crossbar equipment goes to tell-tale or if the panel selectors go to overflow, the subscriber sender will call in another marker and make a second attempt to complete the call. If a failure occurs on the second attempt, a marker will be seized for the third time for the purpose of connecting the calling party to an overflow trunk, thus notifying the subscriber to make a second trial.

If the calling subscriber disconnects before the call is completed, the sender, through the district junctor, releases the calling line immediately, then takes the necessary steps to restore distant selectors which may have been seized before releasing the sender link connection and restoring itself to normal.

In case the sender is arranged for coin operation, a test for the presence of the coin is made after the subscriber has completed dialing and before final unit selection is made or before the call indicator pulses are sent out. This test is cancelled, however, on calls to operators.

ORIGINATING MARKER CONNECTOR FRAME

An originating marker connector circuit includes a maximum of ten pairs of multicontact relays for connection to senders a minimum of three and a maximum of eight pairs of multicontact relays for connection to originating markers, and the associated control and alarm equipment. There are three connector circuits per marker connector frame.

Each originating marker connector is arranged to serve a maximum of ten subscriber senders, or a maximum of eight subscriber and key pulsing senders combined (see Fig. 2). The total number of senders in a connector is reduced to eight when any key pulsing senders are included to avoid delays in these connectors, as key pulsing senders handle heavier traffic than subscriber senders. For the same reason, not more than three key pulsing senders are included in any one connector circuit.

When arranging the subscriber senders of an office in link sub-groups and when locating them in originating marker connector circuits, it is desirable to have all the senders of a link sub-group in the same connector circuit. If all the senders of a link sub-group cannot be located in one connector, they shall not be located in more than two connectors.

From a safety standpoint and to take care of emergencies, the key pulsing senders of a group are distributed over at least four marker connectors.

In general, the subscriber senders located on a sender frame are served by the same connector. No sender is served by more than one connector. The originating markers, however, are multipled throughout all the originating marker connectors, so that any sender may be connected to any originating marker. The circuits are so arranged that only one pair of sender multicontact relays and one pair of decoder marker multicontact relays in a particular marker connector can be operated at one time, and only one pair of originating marker multicontact relays belonging to a particular marker can be operated at one time.

The connector circuits of an office are divided into as many blocks as there are originating marker circuits, each block taking a different one of the originating markers as first choice. If that one is busy, the nearest idle one is selected, the markers being arranged in a definite order in a chain circuit.

CIRCUIT FUNCTIONS

The originating marker connector circuit is used in conjunction with subscriber and "A" operator key pulsing senders for the purpose of connecting these senders to originating markers.

When a three digit office code, an operator code, or a permanent signal indication is recorded in a subscriber or a key pulsing sender, that circuit connects battery to its start lead to the marker connector circuit. If the marker connector is idle, or after it has served waiting calls in other senders, it operates a pair of multicontact relays for the calling sender. This closes a number of receiving, transmitting, check, and control leads between the sender and the marker connector. A pair of multicontact relays for a preferred originating marker are then operated, closing these leads through to the originating marker.

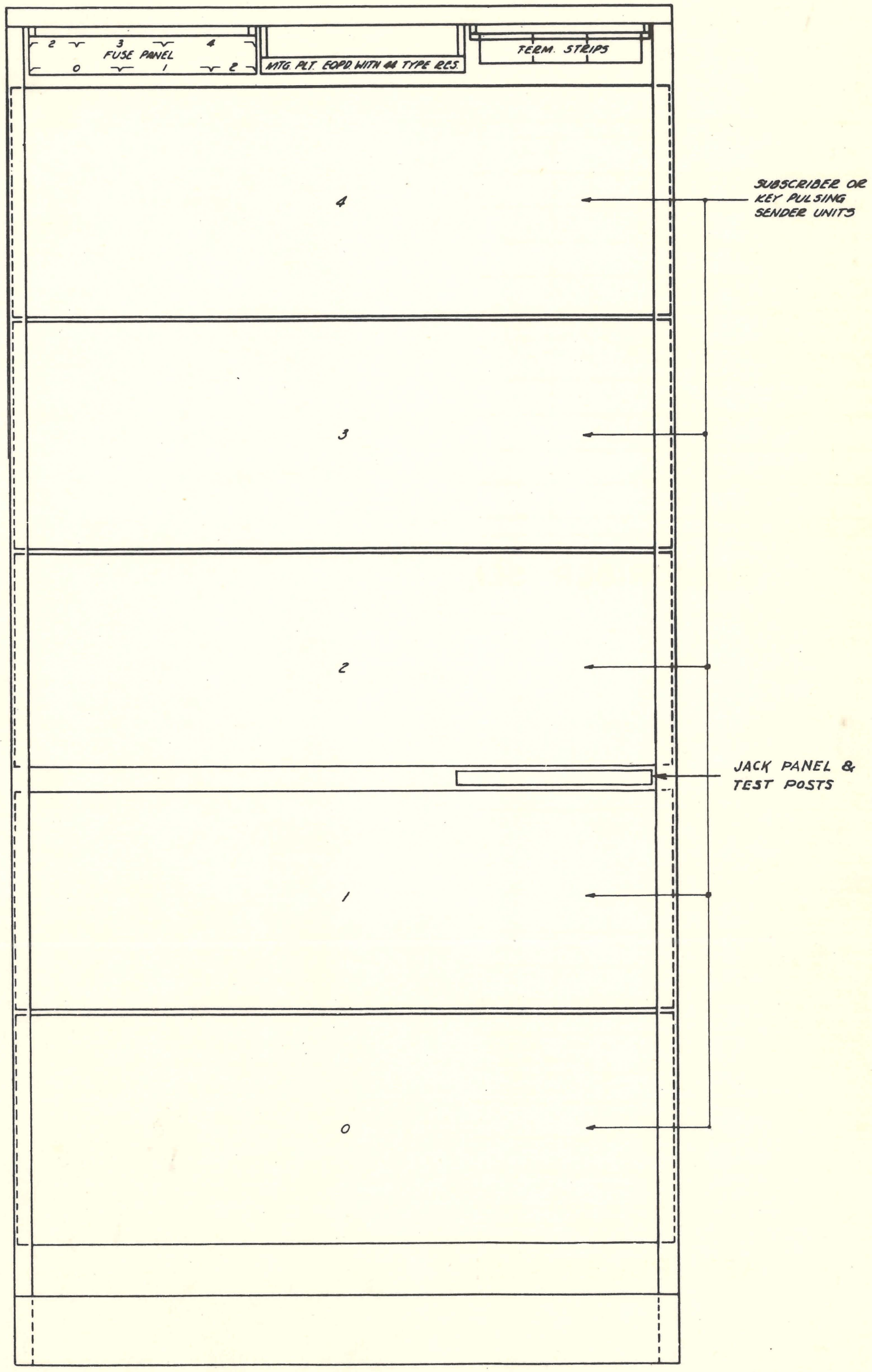
By means of these leads, the marker records the office code dialed, the district frame indication, the class of service of the calling subscriber, and other items of information. It returns to the sender the information it requires for completing the call, and after having found an idle trunk to the called office sends a release signal to the sender. The sender then removes battery from the start lead to the marker connector circuit, releasing all operated relays in the marker connector and returning that circuit to normal.

Under certain trouble conditions or busy conditions, the originating marker may return a trouble release signal to the sender instead of the regular release signal. This causes the sender to release the marker connector as above, and also to close the start lead again to make another attempt, unless the trouble release signal is received on a third trial.

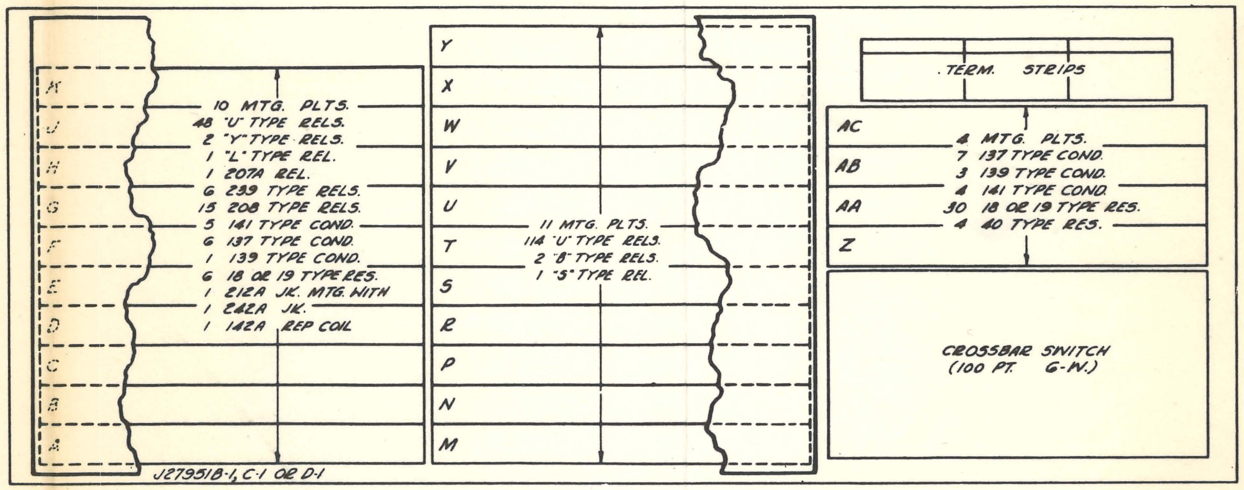
While the originating marker is functioning through the marker connector circuit as above, it holds itself busy to all other marker connectors. Release of the marker connector circuit, however, causes this busy condition to be removed, thereby permitting the originating marker to be reselected. Under these conditions, the decoder functions of the second call take place simultaneously with the marker functions of the first call, these marker functions consisting of the selection of channels and the closure of the path through the district and office link frames to the outgoing trunk.

A timing circuit in each marker connector gives an alarm and makes the associated senders busy in case the marker connector does not respond to a demand from a sender for connection with an originating marker, or in case such a connection when established is held for an excessive length of time. Lamps are provided to indicate the sender and marker involved when a marker connector time alarm is given.

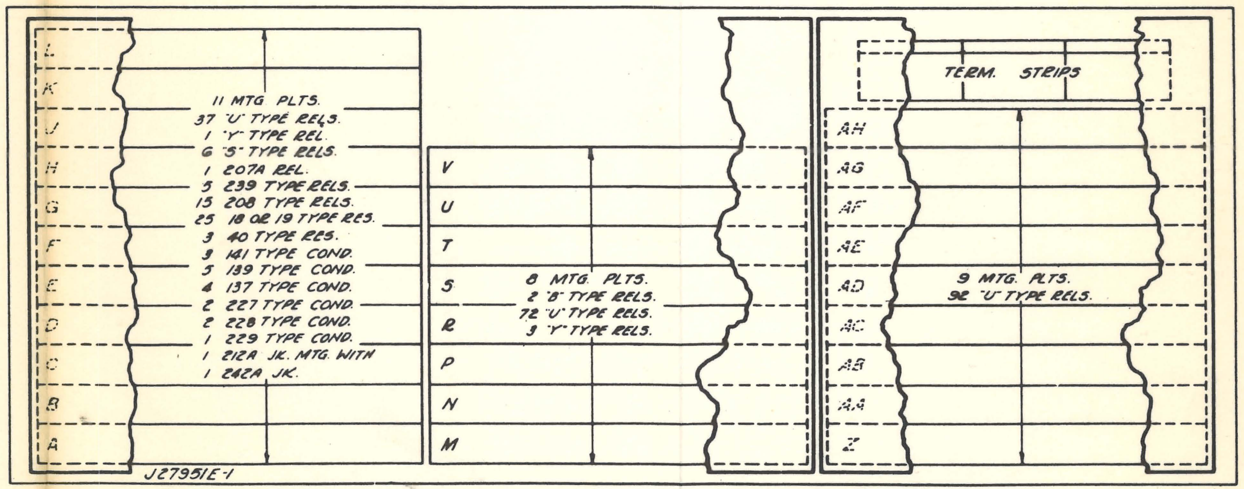
The marker connector circuits are arranged to record on the originating trouble indicator frame the number of the marker connector frame, the number of the marker connector on the frame, and the location of the sender in the connector, in case of a marker failure which obtains access to the trouble indicator.


2
3
4
FUSE PANEL
0
1
2
MTG. PLT. EQPD. WITH 44 TYPE RES.
TERM. STRIPS
4
3
2
1
0
SUBSCRIBER OR KEY PULSING SENDER UNITS
JACK PANEL & TEST POSTS

ORIGINATING SENDER FRAME


K
J
H
G
F
E
D
C
B
A
10 MTG. PLTS.
48 "U" TYPE RELS.
2 "Y" TYPE RELS.
1 "L" TYPE REL.
1 207A REL.
6 239 TYPE RELS.
15 208 TYPE RELS.
5 141 TYPE COND.
6 137 TYPE COND.
1 139 TYPE COND.
6 18 OR 19 TYPE RES.
1 212A JK. MTG. WITH
1 242A JK.
1 142A REP COIL
J279518-1, C-1 OR D-1
Y
X
W
V
U
T
S
R
P
N
M
11 MTG. PLTS.
114 "U" TYPE RELS.
2 "B" TYPE RELS.
1 "S" TYPE REL.
TERM. STRIPS
AC
AB
AA
Z
4 MTG. PLTS.
7 137 TYPE COND.
3 139 TYPE COND.
4 141 TYPE COND.
30 18 OR 19 TYPE RES.
4 40 TYPE RES.
CROSSBAR SWITCH
(100 PT. 6-W.)

SUBSCRIBER SENDER UNIT


L
K
J
H
G
F
E
D
C
B
A
11 MTG PLTS.
37 "U" TYPE RELS.
1 "Y" TYPE REL.
6 "S" TYPE RELS.
1 207A REL.
5 239 TYPE RELS.
15 208 TYPE RELS.
25 18 OR 19 TYPE RES.
3 40 TYPE RES.
3 141 TYPE COND.
5 139 TYPE COND.
4 137 TYPE COND.
2 227 TYPE COND.
2 228 TYPE COND.
1 229 TYPE COND.
1 212A JK. MTG. WITH
1 242A JK.
J27951E-1
V
U
T
S
R
P
N
M
8 MTG. PLTS.
2 "B" TYPE RELS.
72 "U" TYPE RELS.
3 "Y" TYPE RELS.
TERM. STRIPS
AH
AG
AF
AE
AD
AC
AB
AA
Z
9 MTG. PLTS.
92 "U" TYPE RELS.

KEY PULSING SENDER UNIT

Fig. 1 - Originating Sender Frame, Subscriber Sender Unit, And Key Pulsing Sender Unit

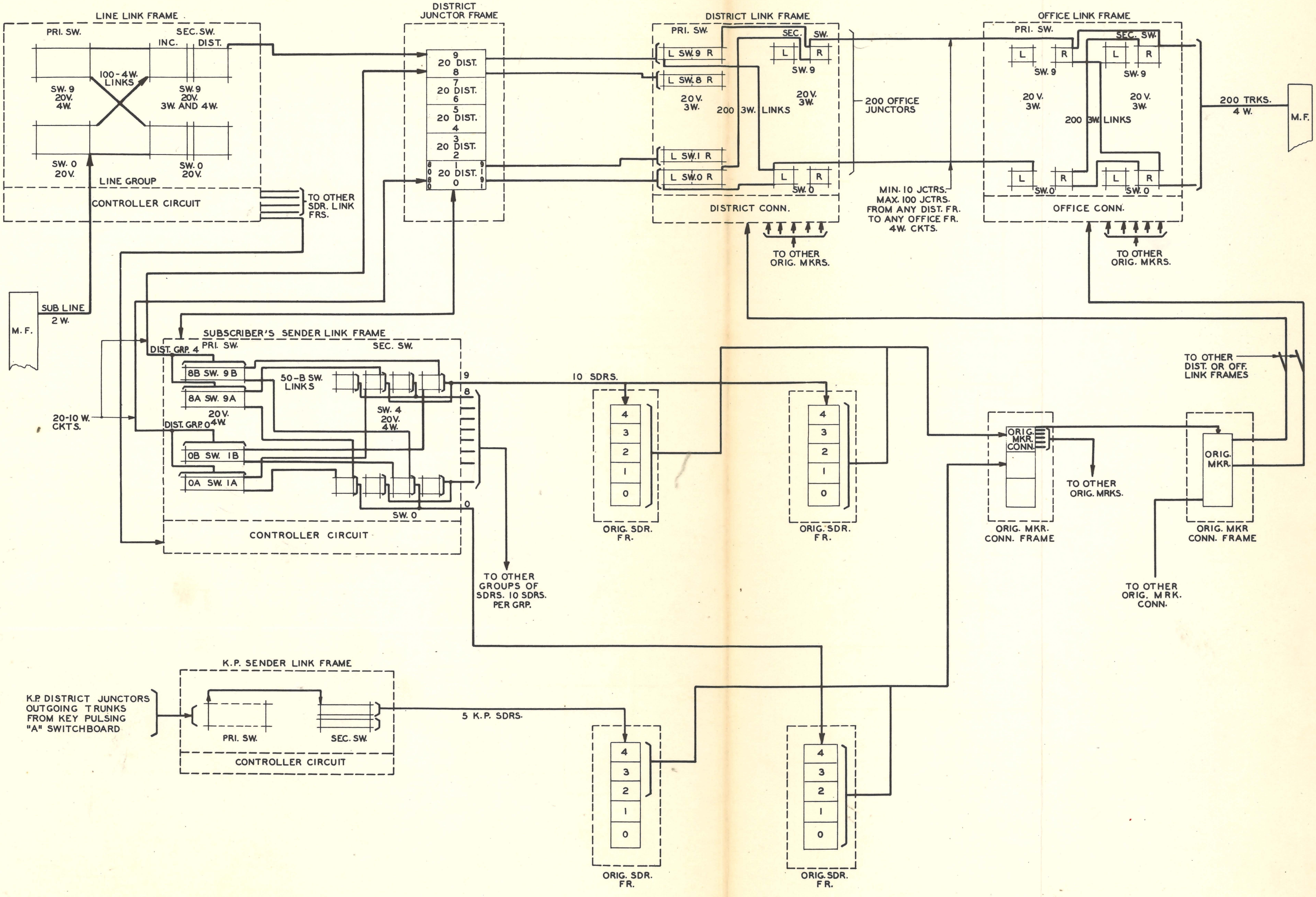

LINE LINK FRAME
PRI. SW.
SEC. SW.
INC.
DIST.
100-4W. LINKS
SW. 9 20V. 4W.
SW. 9 20V. 3W. AND 4W.
SW. 0 20V.
SW. 0 20V.
LINE GROUP
CONTROLLER CIRCUIT
TO OTHER SDR. LINK FRS.
DISTRICT JUNCTOR FRAME
9 20 DIST. 8
7 20 DIST. 6
5 20 DIST. 4
3 20 DIST. 2
1 20 DIST. 0
DISTRICT LINK FRAME
PRI. SW.
SEC. SW.
L SW. 9 R
L SW. 8 R
L SW. 1 R
L SW. 0 R
SW. 9
SW. 0
20V. 3W.
20V. 3W.
200 3W. LINKS
DISTRICT CONN.
TO OTHER ORIG. MKRS.
200 OFFICE JUNCTORS
MIN. 10 JCTRS. MAX. 100 JCTRS. FROM ANY DIST. FR. TO ANY OFFICE FR. 4W. CKTS.
OFFICE LINK FRAME
PRI. SW.
SEC. SW.
L
R
SW. 9
SW. 9
20 V. 3W.
20 V. 3W.
200 3W. LINKS
SW. 0
SW. 0
OFFICE CONN.
TO OTHER ORIG. MKRS.
200 TRKS. 4 W.
M. F.
M. F.
SUB LINE 2 W.
20-10 W. CKTS.
SUBSCRIBER'S SENDER LINK FRAME
DIST. GRP. 4
PRI. SW.
SEC. SW.
8B SW. 9B
8A SW. 9A
50-B SW. LINKS
20V. 4W.
SW. 4 20V. 4W.
DIST. GRP. 0
0B SW. 1B
0A SW. 1A
SW. 0
9
8
0
CONTROLLER CIRCUIT
10 SDRS.
4 3 2 1 0
ORIG. SDR. FR.
ORIG. SDR. FR.
TO OTHER GROUPS OF SDRS. 10 SDRS. PER GRP.
TO OTHER DIST. OR OFF. LINK FRAMES
ORIG. MKR. CONN.
TO OTHER ORIG. MRKS.
ORIG. MKR. CONN. FRAME
ORIG. MKR.
ORIG. MKR CONN. FRAME
TO OTHER ORIG. MRK. CONN.
K.P. SENDER LINK FRAME
K.P. DISTRICT JUNCTORS OUTGOING TRUNKS FROM KEY PULSING "A" SWITCHBOARD
PRI. SW.
SEC. SW.
CONTROLLER CIRCUIT
5 K.P. SDRS.
4 3 2 1 0
ORIG. SDR. FR.
ORIG. SDR. FR.

Fig. 2 - Traffic Schematic Originating Office

<table>
<tr><td colspan="2" rowspan="2"></td><th colspan="3">OFFICE CODE</th><th colspan="5">NUMERICAL CODE</th></tr>
<tr><th>A</th><th>B</th><th>C</th><th>TH</th><th>H</th><th>T</th><th>U</th><th>ST</th></tr>
<tr><td colspan="2">CALLS TO CROSSBAR OFFICE</td><td colspan="3">SENT TO ORIGINATING MARKER TO BE DECODED. MARKER ESTABLISHES A PATH TO A LOCAL OR DISTANT INCOMING TRUNK</td><td colspan="4">THE NUMERICAL CODE IS TRANSMITTED TO THE TERMINATING CROSSBAR SENDER ON A REVERTIVE IMPULSE BASIS</td><td rowspan="9">USED FOR PARTY LETTER OR FIFTH NUMERICAL IN MANUAL OFFICES WITH MORE THAN 9999 LINES</td></tr>
<tr><td colspan="2" rowspan="3">CALLS TO PANEL OFFICE</td><td colspan="3" rowspan="2">SENT TO ORIGINATING MARKER TO BE DECODED. INFORMATION RECEIVED BACK IS USED TO ESTABLISH CONNECTIONS THRU OFFICE BRUSH AND OFFICE GROUP SELECTIONS</td><td>USED TO DIRECT INCOMING BRUSH</td><td>USED TO DIRECT FINAL BRUSH</td><td rowspan="2">USED TO DIRECT FINAL TENS</td><td rowspan="2">USED TO DIRECT FINAL UNITS</td></tr>
<tr><td colspan="2">USED TO DIRECT INCOMING GROUP</td></tr>
<tr><td colspan="7">REVERTIVE IMPULSE BASIS</td></tr>
<tr><td colspan="2" rowspan="2">CALLS TO PANEL SENDER TANDEM</td><td colspan="3">SENT TO ORIGINATING MARKER TO NOTIFY IT TO ESTABLISH A PATH TO SENDER TANDEM OFFICE</td><td colspan="4"></td></tr>
<tr><td colspan="7">THE OFFICE CODE AS WELL AS THE NUMERICAL CODE IS SENT TO THE PANEL TANDEM SENDER AS PCI PULSES</td></tr>
<tr><td rowspan="3">TO MANUAL OFFICES</td><td>DIRECT</td><td colspan="3">SENT ONLY TO ORIGINATING MARKER</td><td colspan="4" rowspan="3">SENT AS PCI PULSES</td></tr>
<tr><td>THRU MANUAL TANDEM</td><td colspan="3">SENT AS PCI PULSES</td></tr>
<tr><td>THRU PANEL OFFICE TANDEM</td><td colspan="3">USED TO ESTABLISH CONNECTIONS THRU OFFICE BRUSH AND GROUP SELECTIONS ON A REVERTIVE PULSE BASIS</td></tr>
</table>

Fig. 3 - Call Progress Chart

CHAPTER 9- ORIGINATING MARKER FRAME

The originating marker frame consists of a two bay frame for common equipment, as shown on Fig. 1, and one or more route relay bays as required. The first bay of the common frame mounts all the relay equipment of the circuit except the multicontact relays. The second bay of the common equipment is arranged to mount the multicontact relays (except route relays) and associated terminal strips, fuse panel, and a number of decoder type cross-connection terminal strips. The route relay bay is arranged for 100 route relays (fifty multicontact relays) and associated multicontact terminal strips and a number of decoder type cross-connection terminal strips.

One of the principal advantages of the crossbar and panel systems over the step-by-step system is the flexibility of the trunking facilities. In crossbar and panel, the size of the trunk group to a particular office may be readily increased, decreased, or rerouted through a tandem point by changing the associated cross-connections in the originating markers or decoder. In fact, the decoder portion of the originating marker is for the purpose of providing this flexibility. These cross-connections for each code or destination are made in conjunction with the route relay or relays provided for each code which is available to the subscriber on an automatic basis.

Terminal strips are provided on the common equipment bay to provide means for making a large number of cross-connections which are more or less common for the whole frame. There is approximately the same amount of cross-connection terminal space on the route relay bays. These are required for cross connecting the 100 route relays mounted on the frame. A number of these terminal punchings are multipled from the common equipment bay to all of the route relay bays. These terminal strips are provided in this manner so that no cross-connections need be made from one bay to another bay. It is also advantageous in making cross-connection changes, thereby minimizing interference with working codes. There are fourteen contact terminals and two winding terminals on each route relay which are cross connected through these terminal punchings.

The two common equipment bays are assembled, wired, and tested in Hawthorne and shipped to the various jobs as one unit. The route relay bay is also assembled, wired, and tested in Hawthorne and shipped as a separate unit. The number of route relay bays varies for each individual job, depending upon the number of route relays required. In general, there is one route relay per code (destination) used. However, for the routes requiring a large number of trunks (over eighty) two route relays will be used. Additional route relays are required for destinations which have an alternate routing. One group of trunks is usually used as an alternate route for several codes. There are a few special codes (usually operator codes) which have multiple routes in order to provide properly for the various classes of service. These require several route relays per code.

The most efficient use of these circuits is to have an originating marker group which would have the maximum number of district and office link frames, twenty each. This would provide ample facilities for more than one 10,000 line unit. Consequently, a number of 10,000 line units may be handled in one originating group of circuits. In order to handle this traffic, means have been provided for a maximum of eight originating markers and a maximum of thirty marker connector circuits which in turn will accommodate 240 to 300 senders depending upon the number of key pulsing senders used. Facilities are provided for connecting any one of the markers in a marker group to a trouble indicator frame which is used to assist the maintenance men in locating troubles.

CIRCUIT FUNCTIONS (SEE FIG. 2)

As soon as the office code has been dialed into the sender, the sender obtains access to an originating marker through an originating marker connector. The marker first checks the leads by which it is connected to the sender through the marker connector for opens and grounds and then records the code which was dialed. At the same time the district link frame number on which the district junctor involved is located and the class of service of the subscriber making the call are recorded. It also records, if the line is a party line, whether the call is from a tip party and in case trouble has been experienced on earlier attempts by the sender, it records whether this is a second or third trial. In case this is a second trial, the marker is arranged to route the call over an alternate route if one is provided; otherwise, the regular route will be selected. On third trials an overflow condition will always be returned to the subscriber.

From the above information, the originating marker transmits back to the sender through the same marker connector information that the sender will require to complete the call, such as class of call, trunk compensating resistance and panel office selections, if required. This is accomplished by the operation of a particular route relay for the code, operated under control of the code information and class of service information received from the sender. This relay operates transmitting relays which ground a selection of leads to the sender. A talking charge relay, operated in series with the route relay, transmits the charge information to the district junctor.

There is always an even number of office link frames in a crossbar office, these frames being arranged in pairs. Each pair of office link frames, with respect to the outgoing trunks, is divided into "trunk levels", each trunk level including forty trunks, located alternately on the even and odd numbered frames. An outgoing trunk group to a particular destination may consist of the entire forty trunks of a trunk level, or it may consist of any smaller even number of trunks within a trunk level, or it may be divided into two or more sub-groups appearing in the trunk levels of different pairs of office link frames.

The route relay operated for the call, in addition to controlling the information transmitted to the sender, associates with the marker the pair of office link frames on which the desired trunks are located, causes the sleeve leads of the trunks of the required trunk level to be connected to the marker, and determines the location of the desired trunks within the trunk level. The marker then tests these trunks, seizing and making busy the first idle one.

The district frame involved is connected to the marker under control of the district frame indication received from the sender. At this time the primary select magnet associated with the district junctor is operated, the sleeve leads of the district links available to this district junctor are extended to the marker, and the secondary select magnets associated with the links are operated.

The district frame information and the office frame information, in combination, causes the operation of a certain junctor connector relay on the district link frame and the operation of a "pattern" relay in the marker. These relays are used to indicate the location of the office junctor circuits connecting the particular district frame to the particular office frame on which the selected trunk is located. On certain combinations of district and office link frames it is desirable from a cabling and cross-connection standpoint to care for irregular locations of office junctors by blanking out the positions of certain office junctors which are not equipped in some particular cases.

After selection of a trunk, the marker sends a release signal to the sender, causing the sender to release the connector circuit. It also causes the district frame to extend to the marker the sleeve leads of the office junctors and it causes the office frame to extend to the marker the sleeve leads of the office links which terminate at the office secondary switch on which the selected trunk is located, and to operate the primary select magnets associated with these links. At this time also the office frame secondary select magnet for the selected trunk is operated.

A "channel" for connecting a district junctor to a trunk consists of a district link, an office junctor, and an office link. The number of channels available for connecting a particular district junctor to a particular selected trunk depends upon the number of office link frames installed, as the office junctors of a particular district frame are equally distributed over the office frames. This number is reduced to one-half if the trunk level involved is "split", as in this case only the left half or the right half of the links and junctors can be used, whereas for "non-split" trunk levels, both halves are available. In any case, not more than twenty channels are tested at one time.

With the sleeve leads of the available district links, office junctors, and office links connected as described above, the decoder marker tests the channels and selects the first one encountered having all three of its parts idle. It then operates the district and office primary and secondary hold magnets for the selected channel, and releases the operated select magnets as the marker returns to normal.

As described above, the marker does not send a release signal to the sender until it has determined that an idle trunk is available. If a trunk group is divided into two sub-groups, and all the trunks of the first sub-group tested are found busy, the other sub-group is tested. If a trunk group is divided into three sub-groups, one of the first two may be tested as above, due to operation of the original route relay, and if found busy, the third or common sub-group is tested through the operation of a second route relay.

Alternate routes through tandem or 2 wire office centers may be provided as an additional choice common to a number of original routes. If all the trunks of an original route are found busy and there is an alternate route, the alternate route relay is operated for testing these trunks. A second alternate route relay may be provided as described for an original route if there are three or more trunk sub-groups. If all alternate route trunks are busy, or if all original route trunks are busy and there is no alternate route, the marker connects the district junctor to an overflow trunk which returns overflow tone to the calling subscriber.

If any of the leads to the sender or district junctor are open, shorted, or falsely grounded, or if there are double connections or false grounds on the channel selected or in case some lead in the marker is shorted or open in a way to block the circuit functions, the marker seizes the originating trouble indicator to leave a record of the trouble. It then sends a trouble release signal to the sender so that the sender may release and make another attempt to complete the call.

In case an idle trunk is found but no channels to that trunk are available, the trunk group is tested again, the trunks on the frame which cannot be reached, however, being caused to appear busy. This is done in an attempt to find an idle trunk on the other office frame of the pair. If a trunk and channel are found in this way, the call proceeds as in regular operation. If no trunk can be found on this frame, or if there is an idle trunk but no channel to it, a trouble release signal is sent to the sender. Since a regular release signal has already been sent and the selection register information in the sender has consequently been locked in, it is impossible in this case to progress to second choice or alternate route trunks on the same trial.

A trouble release signal may also be sent in other special cases, such as all overflow trunks busy on a first or second trial.

A trouble release signal may be sent to the sender either through the marker connector or through the district junctor and sender link after the marker connector is released. It may be sent by way of the district junctor and sender link if a trouble condition or a busy condition involving the marker functions occurs after the transmission of a regular release signal through the marker connector.

Reception of a trouble release signal, by the sender causes it to make a second or third trial regardless of a regular release signal which it may have already received.

On a second trial, trunk testing starts at the alternate route trunks, if there is an alternate route. It may progress to the second alternate route relay, if there is one, and then to the overflow trunks under busy conditions. If there is no alternate route, the original route trunks are tested as on a first trial, except that on any second trial the order of testing the trunks is reversed.

On a third trial, the overflow trunks alone are tested. A regular release signal is sent to restore the sender under these conditions whether or not an idle overflow trunk is found, as a trouble release signal on a third trial causes a stuck sender.

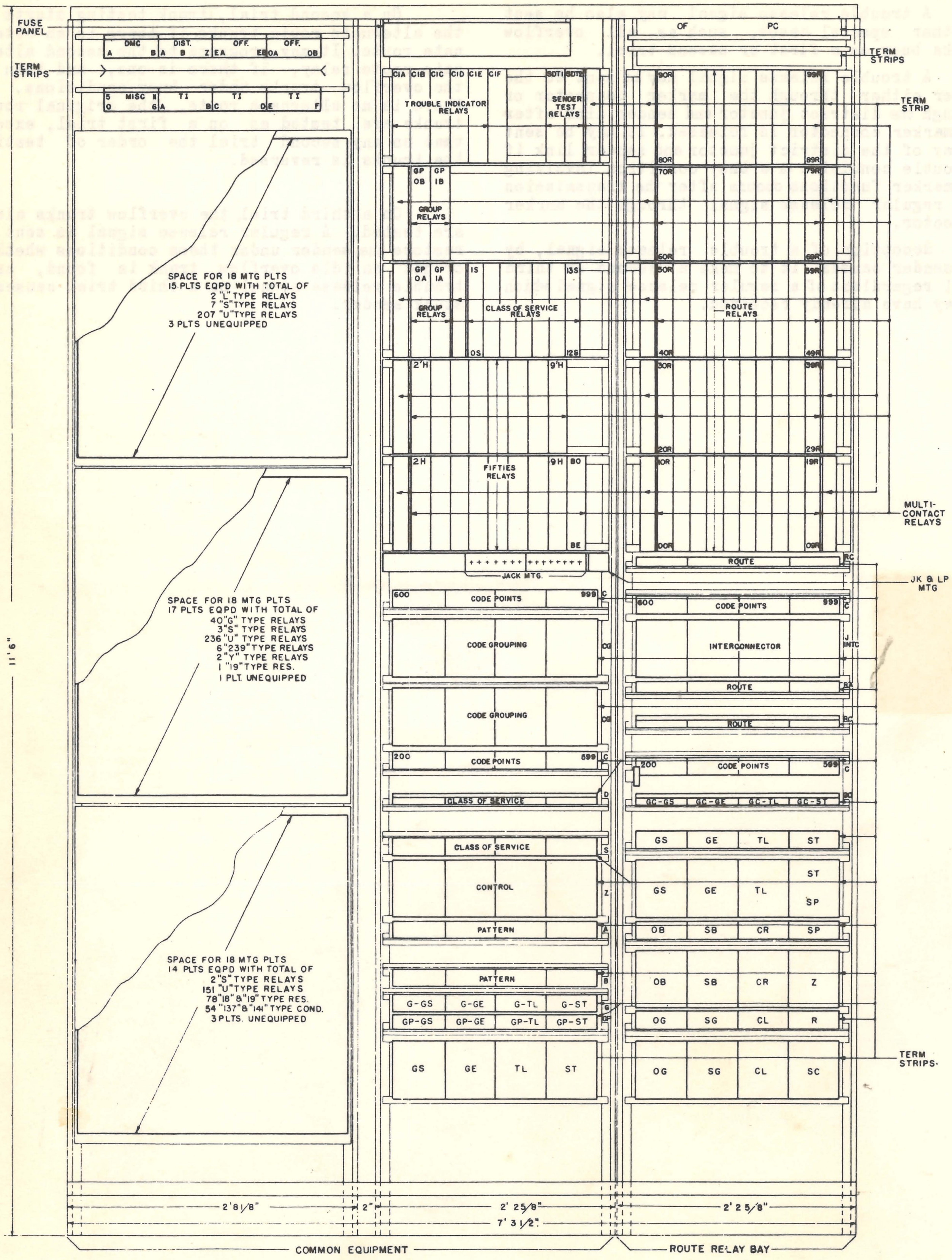

FUSE PANEL
TERM STRIPS
DMC
DIST.
OFF.
OFF.
A
B A
B
Z EA
EB OA
OB
5
MISC
TI
TI
TI
O
6 A
B C
D E
F
SPACE FOR 18 MTG PLTS
15 PLTS EQPD WITH TOTAL OF
2 "L" TYPE RELAYS
7 "S" TYPE RELAYS
207 "U" TYPE RELAYS
3 PLTS UNEQUIPPED
SPACE FOR 18 MTG PLTS
17 PLTS EQPD WITH TOTAL OF
40 "G" TYPE RELAYS
3 "S" TYPE RELAYS
236 "U" TYPE RELAYS
6 "239" TYPE RELAYS
2 "Y" TYPE RELAYS
1 "19" TYPE RES.
1 PLT. UNEQUIPPED
SPACE FOR 18 MTG PLTS
14 PLTS EQPD WITH TOTAL OF
2 "S" TYPE RELAYS
151 "U" TYPE RELAYS
78 "18" 8 "19" TYPE RES.
54 "137" 8 "141" TYPE COND.
3 PLTS. UNEQUIPPED
CIA CIB CIC CID CIE CIF
TROUBLE INDICATOR RELAYS
SDT1 SDT2
SENDER TEST RELAYS
GP OB
GP IB
GROUP RELAYS
GP OA
GP IA
IS
13S
GROUP RELAYS
CLASS OF SERVICE RELAYS
OS
12S
2'H
9'H
2H
9H
BO
FIFTIES RELAYS
BE
JACK MTG.
600
CODE POINTS
999
C
CODE GROUPING
CG
CODE GROUPING
CG
200
CODE POINTS
599
C
D
CLASS OF SERVICE
CLASS OF SERVICE
S
CONTROL
Z
PATTERN
A
PATTERN
B
G-GS
G-GE
G-TL
G-ST
G
GP-GS
GP-GE
GP-TL
GP-ST
GP
GS
GE
TL
ST
OF
PC
TERM STRIPS
TERM STRIP
90R
99R
80R
89R
70R
79R
60R
69R
50R
59R
ROUTE RELAYS
40R
49R
30R
39R
20R
29R
10R
19R
00R
09R
MULTI-CONTACT RELAYS
ROUTE
RC
JK & LP MTG
600
CODE POINTS
999
C
J
INTERCONNECTOR
INTC
ROUTE
RX
ROUTE
RC
200
CODE POINTS
599
C
GC-GS
GC-GE
GC-TL
GC-ST
GC
GS
GE
TL
ST
GS
GE
TL
ST
SP
OB
SB
CR
SP
OB
SB
CR
Z
OG
SG
CL
R
OG
SG
CL
SC
TERM STRIPS
11' 6"
2' 8 1/8"
2"
2' 2 5/8"
2' 2 5/8"
7' 3 1/2"
COMMON EQUIPMENT
ROUTE RELAY BAY

Fig. 1 - Originating Marker Frame

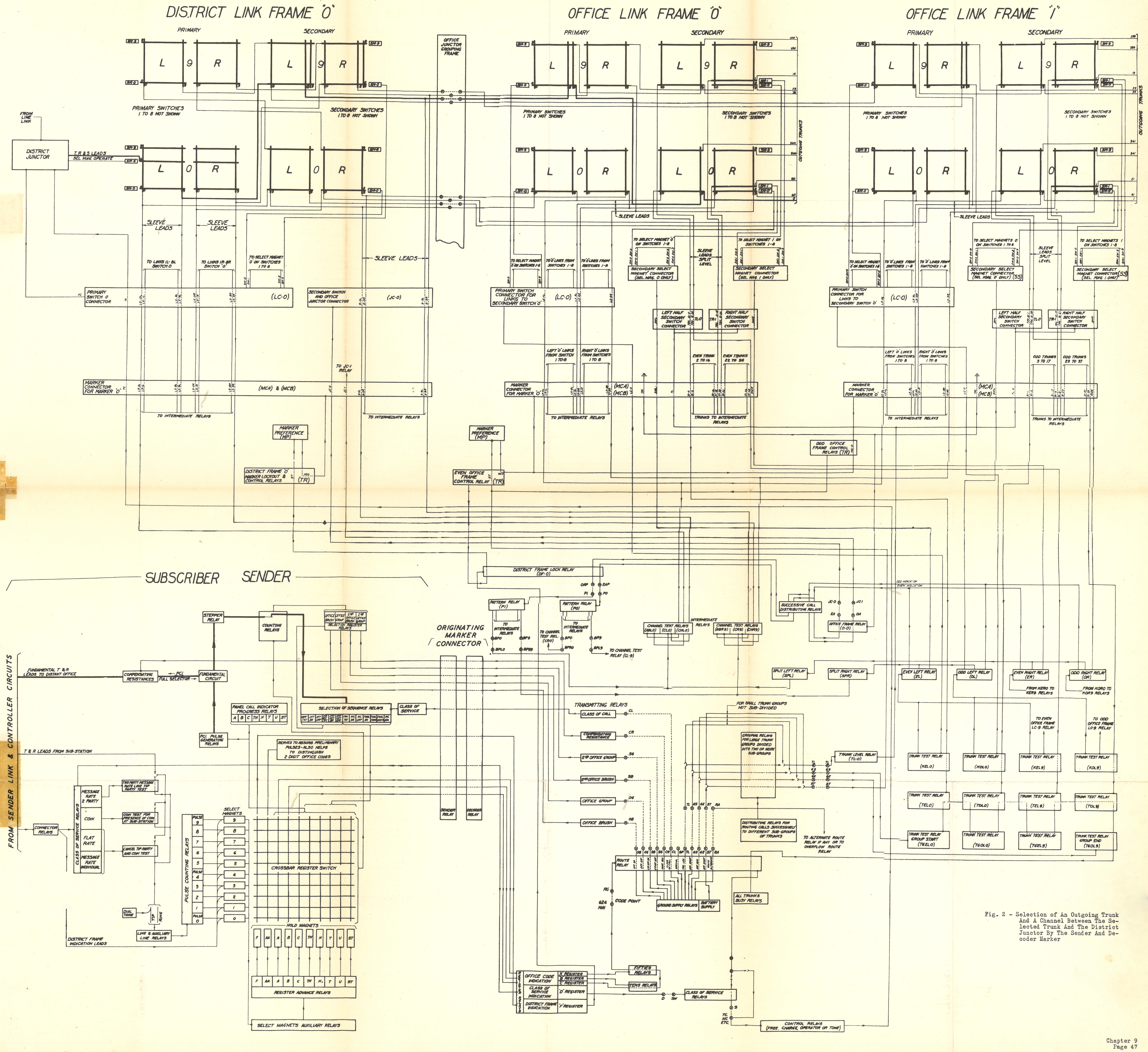

DISTRICT LINK FRAME "0"
OFFICE LINK FRAME "0"
OFFICE LINK FRAME "1"
PRIMARY
SECONDARY
L 9 R
L 0 R
PRIMARY SWITCHES 1 TO 8 NOT SHOWN
SECONDARY SWITCHES 1 TO 8 NOT SHOWN
OFFICE JUNCTOR GROUPING FRAME
OUTGOING TRUNKS
FROM LINE LINK
DISTRICT JUNCTOR
T, R & S LEADS
SEL. MAG. OPERATE
SLEEVE LEADS
TO LINKS 1L-8L SWITCH 0
TO LINKS 1R-8R SWITCH "0"
TO SELECT MAGNET "0" ON SWITCHES 1 TO 8
PRIMARY SWITCH 0 CONNECTOR
(LC-0)
SECONDARY SWITCH AND OFFICE JUNCTOR CONNECTOR
(JC-0)
PRIMARY SWITCH CONNECTOR FOR LINKS TO SECONDARY SWITCH "0"
SECONDARY SELECT MAGNET CONNECTOR (SEL. MAG. 0 ONLY)
SECONDARY SELECT MAGNET CONNECTOR (SEL. MAG. 1 ONLY)
SLEEVE LEADS SPLIT LEVEL
LEFT HALF SECONDARY SWITCH CONNECTOR
RIGHT HALF SECONDARY SWITCH CONNECTOR
TLO
TR
(SS)
LEFT "0" LINKS FROM SWITCH 1 TO 8
RIGHT "0" LINKS FROM SWITCHES 1 TO 8
EVEN TRUNKS 2 TO 16
EVEN TRUNKS 22 TO 36
ODD TRUNKS 3 TO 17
ODD TRUNKS 23 TO 37
MARKER CONNECTOR FOR MARKER "0"
(MCA) & (MCB)
TO JC-1 RELAY
TO INTERMEDIATE RELAYS
TRUNKS TO INTERMEDIATE RELAYS
MARKER PREFERENCE (MP)
DISTRICT FRAME "0" MARKER LOCKOUT & CONTROL RELAYS (TR)
EVEN OFFICE FRAME CONTROL RELAY (TR)
ODD OFFICE FRAME CONTROL RELAYS (TR)
SUBSCRIBER SENDER
DISTRICT FRAME LOCK RELAY (DF-0)
PATTERN RELAY (P1)
PATTERN RELAY (P0)
TO INTERMEDIATE RELAYS
TO CHANNEL TEST REL. (CR0)
TO CHANNEL TEST RELAY (CL-9)
CHANNEL TEST RELAYS (ABL0) (CL0) (CHL0)
INTERMEDIATE RELAYS
CHANNEL TEST RELAYS (ABR9) (CR9) (CHR9)
SUCCESSIVE CALL DISTRIBUTING RELAYS
OFFICE FRAME RELAY (O-O)
ODD INDICATION
EVEN INDICATION
ORIGINATING MARKER CONNECTOR
STEPPER RELAY
COUNTING RELAYS
OFFICE BRUSH GROUP
SELECTION REGISTER RELAYS
FUNDAMENTAL T & R LEADS TO DISTANT OFFICE
COMPENSATING RESISTANCES
PCL
FULL SELECTOR
FUNDAMENTAL CIRCUIT
PCI. PULSE GENERATING RELAYS
PANEL CALL INDICATOR PROGRESS RELAYS
A B C TH H T U ST
SELECTION OF SEQUENCE RELAYS
CLASS OF SERVICE
SERVES TO ABSORB PRELIMINARY PULSES-ALSO HELPS TO DISTINGUISH 2 DIGIT OFFICE CODES
T & R LEADS FROM SUB-STATION
FROM SENDER LINK & CONTROLLER CIRCUITS
CONNECTOR RELAYS
CLASS OF SERVICE RELAYS
MESSAGE RATE 2 PARTY
COIN
FLAT RATE
MESSAGE RATE INDIVIDUAL
TWO PARTY MESSAGE RATE LINE TIP PARTY TEST
COIN TEST FOR PRESENCE OF COIN AT SUB-STATION
CANCEL TIP PARTY AND COIN TEST
DIAL TONE
TIP
RING
LINE & AUXILIARY LINE RELAYS
DISTRICT FRAME INDICATION LEADS
PULSE COUNTING RELAYS
SELECT MAGNETS
9 8 7 6 5 4 3 2 1 0
CROSSBAR REGISTER SWITCH
HOLD MAGNETS
F AA A B C TH H T U ST
REGISTER ADVANCE RELAYS
SELECT MAGNETS AUXILIARY RELAYS
SENDER RELAY
DECODER RELAY
SPLIT LEFT RELAY (SPL)
SPLIT RIGHT RELAY (SPR)
EVEN LEFT RELAY (EL)
ODD LEFT RELAY (OL)
EVEN RIGHT RELAY (ER)
ODD RIGHT RELAY (OR)
FROM KERO TO KER9 RELAYS
FROM KORO TO KOR9 RELAYS
TRANSMITTING RELAYS
CLASS OF CALL
COMPENSATING RESISTANCE
2ND OFFICE GROUP
2ND OFFICE BRUSH
OFFICE GROUP
OFFICE BRUSH
FOR SMALL TRUNK GROUPS NOT SUB-DIVIDED
GROUPING RELAYS FOR LARGE TRUNK GROUPS DIVIDED INTO TWO OR MORE SUB-GROUPS
TRUNK LEVEL RELAY (TL-0)
TO EVEN OFFICE FRAME LC-9 RELAY
TO ODD OFFICE FRAME LC-9 RELAY
TRUNK TEST RELAY (KEL0)
TRUNK TEST RELAY (KOL0)
TRUNK TEST RELAY (KEL9)
TRUNK TEST RELAY (KOL9)
TRUNK TEST RELAY (TEL0)
TRUNK TEST RELAY (TOL0)
TRUNK TEST RELAY (TEL9)
TRUNK TEST RELAY (TOL9)
TRUNK TEST RELAY GROUP START (TGEL0)
TRUNK TEST RELAY (TGOL0)
TRUNK TEST RELAY (TGEL9)
TRUNK TEST RELAY GROUP END (TGOL9)
DISTRIBUTING RELAYS FOR ROUTING CALLS SUCCESSIVELY TO DIFFERENT SUB-GROUPS OF TRUNKS
TO ALTERNATE ROUTE RELAY IF ANY OR TO OVERFLOW ROUTE RELAY
ROUTE RELAY
OB OG SB SG CR CL SP TL 63 62 ST RA
GROUND SUPPLY RELAYS
BATTERY SUPPLY
ALL TRUNKS BUSY RELAYS
RC
624 MAI
CODE POINT
OFFICE CODE INDICATION
CLASS OF SERVICE INDICATION
DISTRICT FRAME INDICATION
"A" REGISTER
"B" REGISTER
"C" REGISTER
"D" REGISTER
"F" REGISTER
FIFTIES RELAYS
TENS RELAYS
CLASS OF SERVICE RELAYS
CONTROL RELAYS (FREE, CHARGE, OPERATOR OR TONE)
TC NC ETC.

Fig. 2 - Selection of An Outgoing Trunk And A Channel Between The Selected Trunk And The District Junctor By The Sender And Decoder Marker

CHAPTER 10 - TERMINATING SENDER LINK, INCOMING TRUNK AND INCOMING LINK FRAMES - LINE JUNCTOR DISTRIBUTION

The terminating sender link frame, incoming trunk frame, and incoming link frame which are grouped on the floor in a manner similar to the district frame group of the originating office, accommodates 100 incoming trunks. This association of frames, as was the case with the district group, facilitates maintenance and the wiring between frames.

Interoffice trunks incoming to a crossbar office terminate on the horizontals of primary switches on an incoming link frame. Line junctors to line link frames appear on the verticals of the secondary switches of this frame and 200 incoming links provide the access between primary and secondary switches. The incoming trunks also appear on the horizontals of primary switches on the terminating sender link frames for access to terminating senders of the full selector or "B" type. The incoming trunks themselves are mounted in units on a two bay framework similar to the district junctor frame previously discussed for the originating office.

INCOMING TRUNK FRAME

The incoming trunk frame illustrated on Fig. 1 will mount five incoming trunk units. Each incoming trunk unit is arranged for twenty single mounting plate trunks and provides terminal strip capacity for twenty trunks. Certain incoming trunks require two mounting plates, however, and this reduces the capacity of the units on which they are mounted to less than twenty. When several of the units furnished on an incoming trunk frame do not mount their full capacity of twenty trunks, which is usually the case, a supplementary incoming trunk frame is provided. The added trunks required to properly load the partially equipped trunk groups of the regular incoming trunk frames are mounted on units on the supplementary frame and connected by means of switchboard cable to the terminal strips of the various partially equipped regular units. Incoming trunk frames are furnished on the basis of one frame per 100 (or slightly less) incoming trunks in the office. The number of incoming trunks required per office is based on the number of incoming calls, each 100 trunks handling from 1500 to 2000 ccs.

Each incoming trunk unit is shipped separately and mounted on the frame on the job. Each unit accommodates two incoming trunk groups of ten or less incoming trunks each. Each of the groups on a unit is associated with a different incoming link primary switch, one odd and one even.

INCOMING TRUNKS

In general, there are three classes of incoming trunks, full selector, "B" switchboard and key pulsing. Full selector incomings are, in general, those originating in panel or crossbar offices which require access through the terminating sender link frame to full selector senders for the completion of a call. The "B" switchboard incomings are those which originate in manual offices or at manual tandem or toll switchboards and require access to "B" senders through the sender link and to a call distributing "B" position in the terminating crossbar office for the completion of calls. Key pulsing incomings are those from switchboard positions equipped with keysets. These incomings have access to key pulsing senders through the key pulsing sender link frame for registration of the number set up on the operator's keyset. They also connect to terminating senders through the terminating sender link frame. The number set up in the key pulsing sender is spilled into the terminating sender on each call, terminating senders not being arranged to register key pulses direct.

The three classes of trunks and the type of senders required may be listed as follows:

	Type Sender Req'd.
1. Full Selector Service	
(a) Incoming from panel, crossbar or sender tandem - Local grade transmission	Full Selector
(b) Incoming from No. 3 toll (Delayed Ringing)	Full Selector
(c) Incoming from No. 3 toll (Immediate Ringing) or sender tandem - Toll grade transmission	Full Selector
(d) Incoming from OGT test frame	Full Selector
2. "B" Switchboard	
(a) Incoming from manual or manual tandem - Local grade transmission	B

	Type Sender Req'd.
(b) Incoming from DSA switchboard - Regular	B
(c) Incoming from DSA switchboard - No-test	B
(d) Incoming from No. 1 toll (Delayed Ringing)	B
(e) Incoming from No. 1 toll (Immediate Ringing) or manual tandem - Toll grade transmission	B
(f) Incoming from local test desk - Regular	B
(g) Incoming from local test desk - No-test	B
(h) Incoming from line message register rack	B
(j) Incoming from toll - Number checking	B
3. Key Pulsing	
(a) Incoming from key pulsing "A" Switchboard - Regular	Full Selector
(b) Incoming from key pulsing "A" Switchboard - No-test	Full Selector

With a few exceptions, the types of service furnished by the above incoming trunks are self-explanatory and correspond to similar types of service furnished by panel incoming selectors. The incoming trunk from the outgoing trunk test frame (1d) and the incoming from line message register rack (2h) are used for maintenance work in making various tests on subscriber lines. The incoming trunk from toll number checking is used by the toll operator in verifying the number of a subscriber originating a toll call.

Incoming trunks, in general, perform the same duties as do the incoming selectors of the panel system. Each incoming trunk includes a relay circuit which provides talking battery and supervision for the called subscriber and rings the called subscriber's bell. In addition, they return overflow or line busy indications to the calling subscriber in case the call cannot be completed.

TERMINATING SENDER LINK FRAME

The frame is arranged to mount three 100 point 6 wire primary and three 100 point 6 wire secondary crossbar switches together with the associated control equipment. The frame is completely assembled and wired in the shop, the only variables being the equipment required by sender sub-groups having only terminating senders or by sub-groups having senders of both types. When the terminating sender link frames are installed on the job they are always located to the left of and adjacent to their associated incoming trunk frames. The connections between the sender link primary switches and the incoming trunks are included in local cable arms extending from the link frame local cable to the terminal strips of the associated incoming trunk units. The control circuits of a pair of link frames are arranged to work on a mate frame basis to care for emergencies in which one control circuit might be out of order.

The three sub-groups of ten senders each available to the terminating sender link may contain both full selector and "B" senders in each sub-group and for this reason it is necessary that some provision be made to select the proper type of sender to handle each call. This selection is accomplished by putting in each group of ten incoming trunks only those requiring the same type of sender. The three terminating sender links serving each group of ten incoming trunks can then be arranged to select only full selector or only "B" senders as the case may require. The terminating sender link frame illustrated on Fig. 2A provides a location for the link and associated control equipment required to establish connections between incoming trunk circuits and full selector or "B" senders.

LINK DISTRIBUTION

The link distribution for the terminating sender link frame is illustrated on Fig. 2B. There are a total of thirty primary switch verticals on the three primary switches of each link frame. These verticals are divided into ten groups of three verticals each as illustrated on Fig. 2B. The ten levels of each of these groups are connected in the link frame local cable to ten incoming trunks on the associated incoming trunk frame. The three verticals that serve each group of ten trunks are connected to verticals of three secondary switches. Primary verticals 0 of each of the ten groups connect to verticals 0 to 9 on secondary switch 0 respectively; primary verticals 1 of each of the ten groups connect to verticals 0 to 9 on secondary switch 1 respectively, etc. The ten 6 wire horizontals of each secondary switch connect to ten full selector or "B" senders. Thus it will be seen that any group of ten incoming trunks has one link or path to each secondary switch or to each sub-group of ten senders. Therefore, any trunk may be served by any one of the group of thirty senders providing all of the senders are of the proper type.

SELECTION OF SENDERS

A terminating sender link frame may serve a trunk frame of 100 full selector trunks or it may serve a frame having a combination of both full selector and "B" switchboard incomings. In the latter case the two types of trunks must be segregated in groups of ten in order that a call may be routed to the proper type of sender. The links serving each group of ten trunks may have access on the secondary switch to both types of senders but are allowed to connect with only one type. This is accomplished by connecting the start lead of the group of ten trunks either to full selector or to "B" sender group start equipment which selects the proper type of sender and permits the operation of only those secondary switch selecting magnets associated with this type of sender. This feature makes possible the combination of both types of senders in one sub-group of ten, the full selector senders being equipped from bottom up in the sub-group of ten on the secondary switch and the "B" senders from top down. The two types of senders within a sub-group of ten work independently of each other except that not more than one call can be completed in a sub-group at a time. Sender selector equipment, located on the miscellaneous frame and associated with the various sender sub-groups, is required in addition to the link control circuit for the process of selecting idle senders.

SENDER MULTIPLE

The three sub-groups of ten or less senders are multipled to other terminating sender link frames as required to properly load the thirty senders. Where more than one group of thirty senders are required, one or two additional groups may be furnished, the maximum being three groups of thirty senders each. A particular incoming trunk frame cannot be served by more than one group of thirty senders.

INCOMING LINK FRAME

The incoming link frame illustrated on Fig. 3A is located to the right of the incoming trunk frame and serves 100 incoming trunks. The incoming trunks appear on the horizontals of primary switches and for this reason the incoming link frame has five local cable arms, one for each incoming trunk unit, which are of sufficient length to be wired to the incoming trunk units after the frames are in place on the floor. These local cable arms carry the incoming trunks to their locations on the incoming link primary switches. Connector circuits are provided on the frame consisting of marker connector and link connector relays. The frame is arranged to mount in the left or primary bay, ten 200 point 3 wire crossbar switches and ten 200 point 3 wire crossbar switches in the right-hand or secondary bay.

The incoming link frame illustrated provides a location for the crossbar switches required to provide paths from the incoming trunk circuits to all line link frames so that any line in the terminating office can be reached from any incoming trunk. The connection from the selected trunk forward toward the called line is through the incoming link frame. Line junctors appear on the verticals of secondary switches on this frame. The line junctor carries the connection forward to a line link which in turn has access to the called line.

The control leads between the incoming trunk and the terminating marker circuit are cut through the make contacts of the frame relay of the incoming trunk and the make contacts of the link connector relay of the incoming link circuit, there being one link connector relay for each group of ten incoming trunks. Over these control leads the marker operates relays in the incoming trunk to control the ringing of the called subscriber's bell or to return overflow or line busy indication to the calling subscriber in case the call cannot be completed.

PRIMARY - SECONDARY SWITCH ARRANGEMENT

The incoming trunks terminate on the primary switch horizontals, ten trunks per primary switch. Two hundred incoming links appear on the verticals of the ten primary switches. The twenty verticals on each primary switch are divided into two groups of ten left and ten right. The ten left verticals of each primary switch are connected, one each, to horizontals on the left half of each secondary switch. The horizontal multiple of the secondary switch is split at the midpoint (see Fig. 4A). The ten right primary verticals terminate in the same manner on the horizontals of the right halves of the secondary switches. The same spread is used for the incoming links between primary and secondary switches as is used for the district links on the district link frame. That is, the 0 to 9 verticals are connected at respective 0 to 9 secondary switches to the horizontal level corresponding in number to the primary switch on which the incoming links originate. This primary-secondary spread is made in the frame local cable. Two hundred line junctors appear on the verticals of secondary switches.

The local cable arms carrying the leads for the incoming links to the right half of the secondary switches are formed long enough to permit them to reach the secondary switches on an incoming extension frame, when furnished. The incoming extension bay is located adjacent to and to the right of the secondary bay. When extension frames are not furnished these local cable arms are bent back on themselves and the slack taken up to permit them to connect to the left end of the right half of regular secondary switches. This procedure permits the same design of local cable to be used whether or not incoming extension frames are used.

INCOMING LINK EXTENSION

In offices having more than ten line choices (forty line link frames) the 200 line junctors outgoing from the secondary switches of an incoming link frame, which is the maximum that can be obtained by the arrangement shown on Fig. 4A, will not be sufficient to handle the traffic to all line link frames. When this condition occurs an additional secondary bay known as an extension bay will be provided with each regular incoming link frame. The arrangement of incoming link frames with extension bays is shown on Fig. 4B. Under this condition it will be noted that the incoming links from the left primary verticals terminate on the horizontals of the regular secondary switch, the horizontal multiple of which is not split in this case. The incoming links from the right primary verticals terminate on the horizontals of the build-out frame secondary switches which also are not split. This increases the number of secondary verticals available to each incoming link from ten to twenty and the total line junctor capacity from 200 to 400 per frame. These 400 line junctor verticals are then multipled to

400 like numbered verticals of the mate incoming link and extension frames since with extension operation incoming link and extension frames are always paired for mate frame operation.

LINE JUNCTOR DISTRIBUTION

The paths between incoming link secondary verticals and the line link secondary switch verticals are known as line junctors. The terminating traffic between incoming link frames and line link frames is routed in accordance with one of two distinct plans, each of which must enable all incoming link frames to reach all line link frames. The first plan provides 200 incoming link secondary verticals or line junctors per incoming link frame and the second 400 incoming secondary verticals or line junctors per incoming group.

DISTRIBUTION - NO INCOMING EXTENSION

This plan will serve two to ten incoming link frames and two to ten line choices. Two hundred line junctors are provided per incoming link frame and no extension secondary switches are required.

Since each incoming link frame is associated with 100 incoming trunks the traffic load to be carried by each incoming link frame is approximately 2,000 ccs. These 100 incoming trunks have 200 outlets which must be distributed evenly to all line link frames. Each line link frame has 100 line links which will carry 1,000 ccs. Assuming that originating and terminating traffic is divided equally then the terminating traffic per line link frame will be 500 ccs. Therefore, each incoming link frame can handle as much terminating traffic as four line link frames. For terminating traffic the four line link frames are referred to as a "line choice". However, the four line link frames have 400 verticals which may be used for incoming traffic, 100 on each secondary bay, and there are 200 line junctors to be terminated on the secondary verticals of the line link frames. Each line choice is, therefore, divided into two half choices ("A" and "B") by multipling the 100 verticals on the secondary bays of two line link frames together. Each half choice (two line link frames) thus uses 100 line junctors in common from the incoming frames. There should not be less than ten line junctors per incoming link per half choice in any case.

Fig. 5 shows in schematic form the manner in which the line junctors are run when the maximum of ten incoming link frames and ten line choices are equipped. This sketch shows only one switch on each frame but like numbered switches on both incoming and line link frames are connected together in the same manner. It will be noted that all left incoming link secondary verticals 0 go to half choice 0-A. The left 0 verticals on incoming link frame zero are connected to the 0 verticals of the line link secondary switches in half choice 0-A; the left 0 verticals on incoming link frame 1 are connected to the 1 verticals of half choice 0-A. The distribution of other junctors can be traced in this manner, the incoming link vertical number being the same as the choice number and the incoming frame number the same as the line link vertical. The right incoming link verticals connect to half choices "B" in the same manner. When less than the maximum of ten incoming link frames or ten line choices are equipped, incoming link verticals from 0 up to the number of equipped frames are connected in the regular manner as shown on Fig.5. Higher numbered verticals are connected in a variable manner in accordance with standard charts for each type of installation in single steps of two to ten incoming link frames.

The terminating marker test channel consisting of an incoming link, line junctor and line link tests in groups of ten. With the ten incoming link and ten half choice arrangement discussed above there are ten of each of these paths available. The 0 channel will consist of the 0 line link through line link secondary switch 0, the 0 line junctor (left or right depending on the half choice) to the 0 secondary switch on the incoming link and the 0 (left or right) incoming link from 0 primary switch on the incoming link to the 0 vertical on the secondary switch. The other nine channels are correspondingly numbered and can be traced in a similar manner.

When less than ten incoming link frames are equipped, the number of junctors from each incoming link frame to each half choice is as follows:

No. of Inc. Link Frs.	No. of Half Choices	No. of Junctors Per Inc. Link Per Half Choice
2	4	50
3	6	33 or 34
4	8	25
5	10	20
6	12	16 or 17
7	14	14 or 15
8	16	12 or 13
9	18	11 or 12
10	20	10

On a terminating call these junctors between incoming frames and line link frames are tested by the terminating marker, ten junctors at one time. The junctor groups indicated above must, therefore, be split into junctor sub-groups of ten or less. In the case of a three incoming link frame size, the junctors are split into three sub-groups of ten and one sub-group of three or four.

The ten line junctors in each sub-group are connected into the terminating marker through a line junctor relay on the line junctor connector frame. There are ten line junctor relays per half choice on each line junctor connector frame, each relay cutting in for test ten of the line junctors from that half choice. Thus, the 100 line junctors to a line half choice are cut through the contacts of ten relays. Accordingly, therefore, on a job requiring three incoming link frames, calls from incoming link frame 0 to half choice 0-A can be completed over one of 33 paths which are tested by the marker 10-10-10 and 3 until an idle path is found.

It will be noted that Plan 1 provides for a maximum of only ten incoming link frames and ten line choices, or forty line link frames. Since there must be a minimum of ten line junctors from each incoming link frame to each half choice, the 200 line junctors of each incoming link frame will provide these ten paths to only twenty half choices or ten line choices. When the ultimate size of the office will exceed the capacity of either ten incoming link frames or ten line choices Plan 2 must be used on the initial installation even though the initial frame requirements are within the scope of Plan 1.

DISTRIBUTION WITH INCOMING EXTENSION

This plan will serve offices with two to ten incoming link groups and four to twenty line choices. Four hundred junctors are provided per incoming group, each incoming group consisting of two incoming link frames and the associated extension bays. With this increase in capacity to 400 line junctors insurance of a satisfactory traffic load on these junctors requires that the 200 junctors on one incoming link frame be multipled to those of another incoming link frame and that the remaining 200 junctors be made common to the two associated extension frames. To explain this point further, the regular secondary bay has access to 200 line junctors as in the previous plan but has only one-half the number of incoming links or paths from the primary bay. Therefore, the 200 junctors will receive but half the traffic from incoming trunks that it will receive under the previous plan or only 1,000 ccs. Multipling the line junctors on the verticals of two regular secondary bays together will provide them with twice this traffic or 2,000 ccs. In addition, multipling the line junctors from two build-out bays together will furnish them with a load of 2,000 ccs. A pair of incoming link secondary bays (on two frames) and a pair of extension bays (on the same two frames) together, therefore, provide a traffic load of 4,000 ccs. and 400 line junctors to carry this traffic to the line link frames. We can fulfill the previous requirement of providing at least ten line junctors to each half choice of line link frames and distribute the 4,000 ccs. to twice as many line link frames as under the previous plan.

This multiple arrangement of two incoming link frames and their two associated build-out frames which have access to a common group of 400 line junctors is called an incoming group. Fig. 6 shows in schematic form the manner in which the line junctors are run when the maximum of ten incoming groups and twenty line choices are furnished. In a manner similar to Fig. 5 only one switch on each frame is shown and multiplication by ten is necessary to present the complete picture. It will be noted that the junctors from the pairs of regular incoming link frames are run to half choices "A" and those from the pairs of extension frames are run to the half choices "B". When less than the maximum of ten incoming link groups or twenty line choices are equipped, verticals from 0 up to the number of equipped frames are connected in a regular manner as shown on Fig. 6. Higher numbered verticals are connected in a variable manner in accordance with standard charts for each type of installation in steps of one group from two to ten incoming groups.

This plan of distribution is similar to that used for the previous plan where the line junctors from left half incoming link secondary switches were run to "A" half choices and those from right half switches to "B" half choices. It is only necessary to visualize the regular secondary switches (with 20 verticals) as corresponding in the second plan to the left half secondary switches (with only ten verticals) in the first plan and the extension secondary switches as corresponding to the right half secondary switches. The general plan of distribution is the same except that the number of verticals and the number of half choices is double that of the previous plan.

When ten incoming groups and twenty line choices are equipped, there are exactly ten line junctors from each incoming group to each half choice. When less than ten incoming groups are equipped, the number of junctors from an incoming link frame to each half choice is as follows:

No. of Inc. Groups	No. of Half Choices	No. of Junctors Per Inc. Grp. Per Half Choices
2	8	50
3	12	33 or 34
4	16	25
5	20	20
6	24	16 or 17
7	28	14 or 15
8	32	12 or 13
9	36	11 or 12
10	40	10

$\frac{400}{8} = 50$

$\frac{200}{4} = 50$

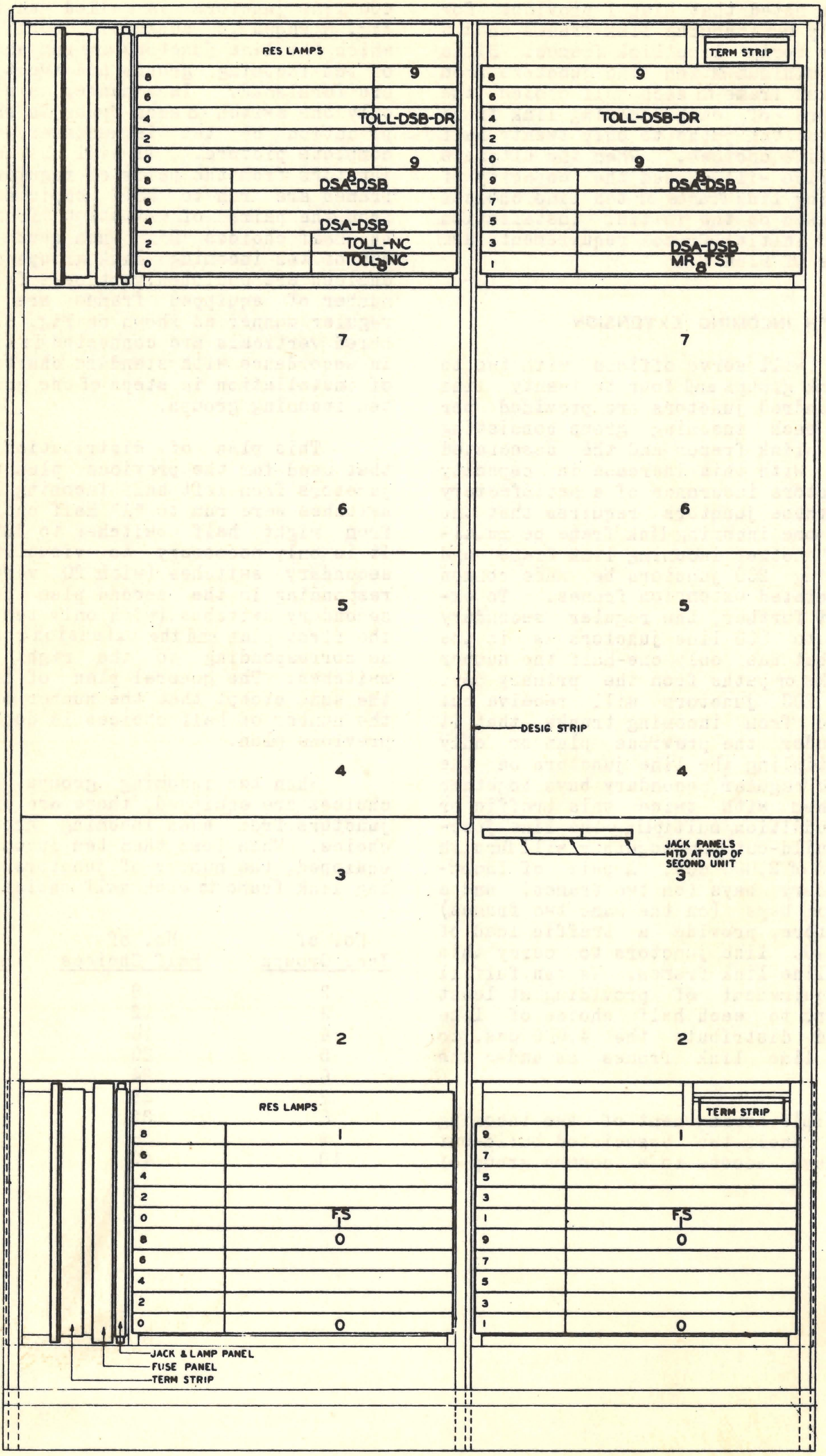

RES LAMPS
TOLL-DSB-DR
DSA-DSB
DSA-DSB
TOLL-NC
TOLL-NC
TERM STRIP
TOLL-DSB-DR
DSA-DSB
DSA-DSB
MR TST
9
8
7
6
5
4
3
2
1
0
DESIG. STRIP
JACK PANELS MTD AT TOP OF SECOND UNIT
RES LAMPS
TERM STRIP
F.S
JACK & LAMP PANEL
FUSE PANEL
TERM STRIP

Fig. 1 - Incoming Trunk Frame

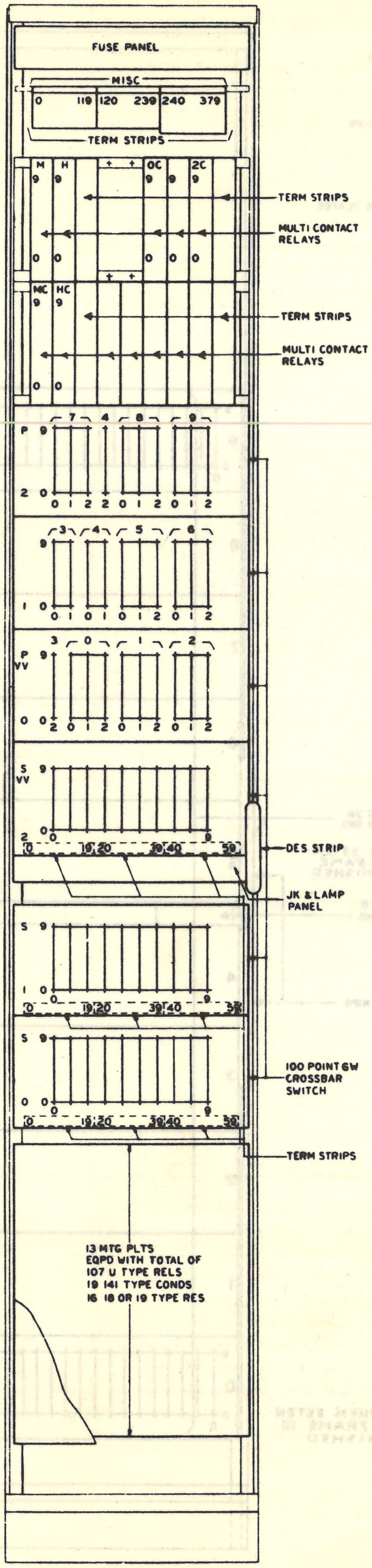

FUSE PANEL
MISC
0 119 120 239 240 379
TERM STRIPS
M H OC 2C
TERM STRIPS
MULTI CONTACT RELAYS
MC HC
TERM STRIPS
MULTI CONTACT RELAYS
P 7 4 8 9
S VV
DES STRIP
JK & LAMP PANEL
100 POINT 6W CROSSBAR SWITCH
TERM STRIPS
0 19 20 39 40 59
13 MTG PLTS
EQPD WITH TOTAL OF
107 U TYPE RELS
19 141 TYPE CONDS
16 18 OR 19 TYPE RES

Fig. 2A - Terminating Sender Link Frame

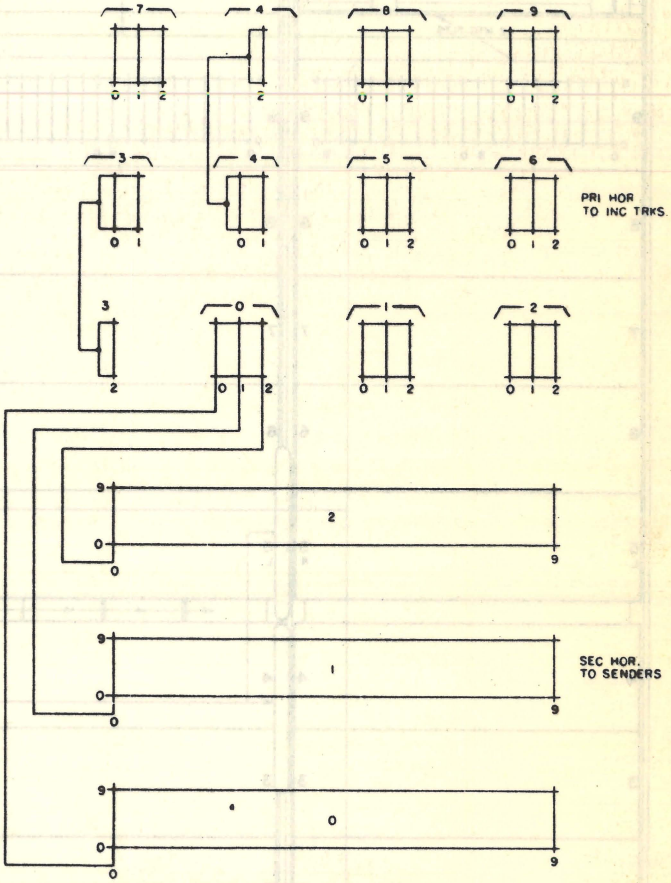

7
4
8
9
3
4
5
6
PRI HOR TO INC TRKS.
3
0
1
2
2
1
0
SEC HOR. TO SENDERS

Fig. 2B - Terminating Sender Link Primary-Secondary Spread

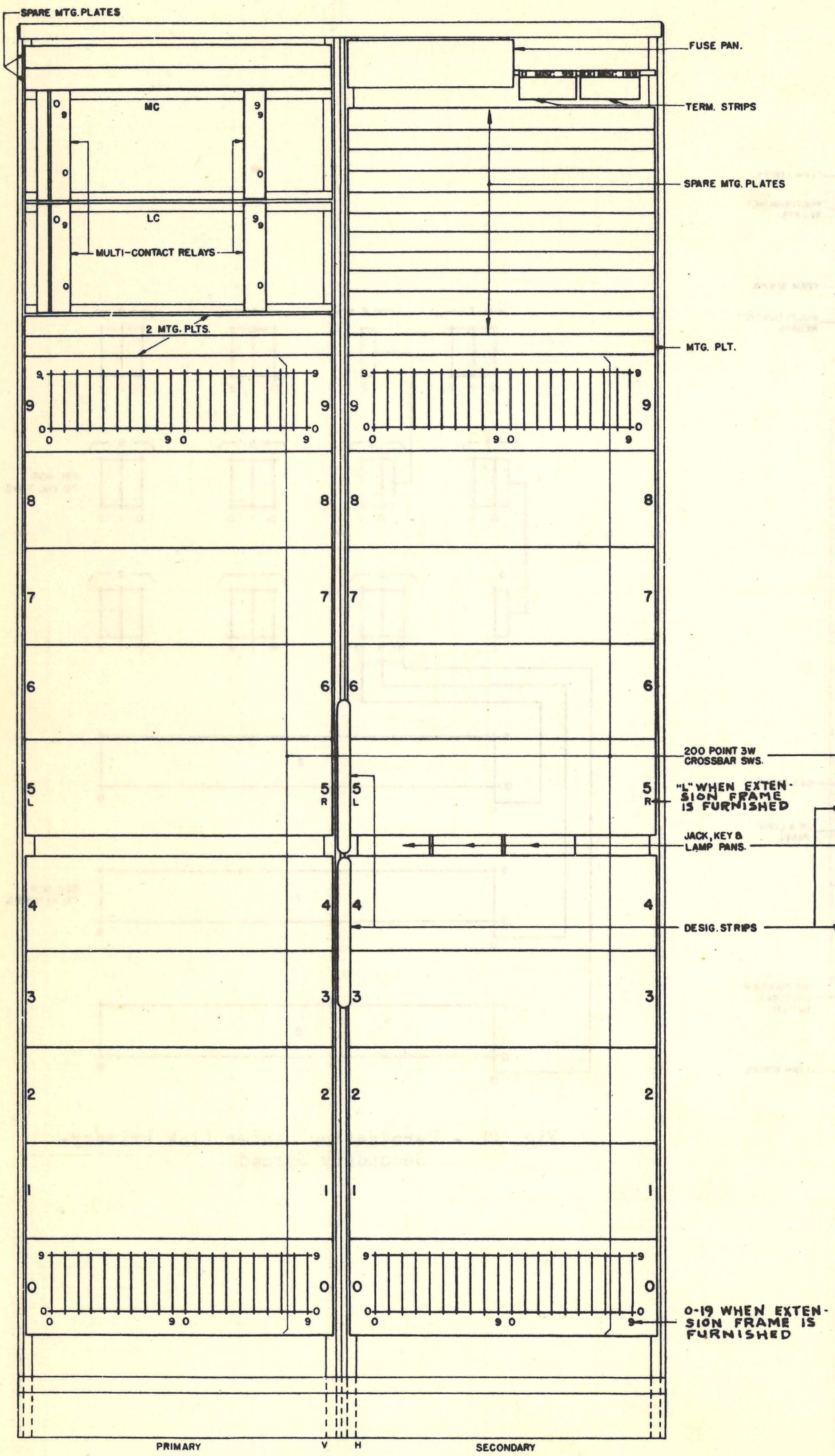

SPARE MTG. PLATES
FUSE PAN.
TERM. STRIPS
MISC.
MC
LC
MULTI-CONTACT RELAYS
SPARE MTG. PLATES
2 MTG. PLTS.
MTG. PLT.
200 POINT 3W CROSSBAR SWS.
"L" WHEN EXTENSION FRAME IS FURNISHED
JACK, KEY & LAMP PANS.
DESIG. STRIPS
0-19 WHEN EXTENSION FRAME IS FURNISHED
9
8
7
6
5
L
R
4
3
2
1
0
90
PRIMARY
V
H
SECONDARY

Fig. 3A - Incoming Link Frame

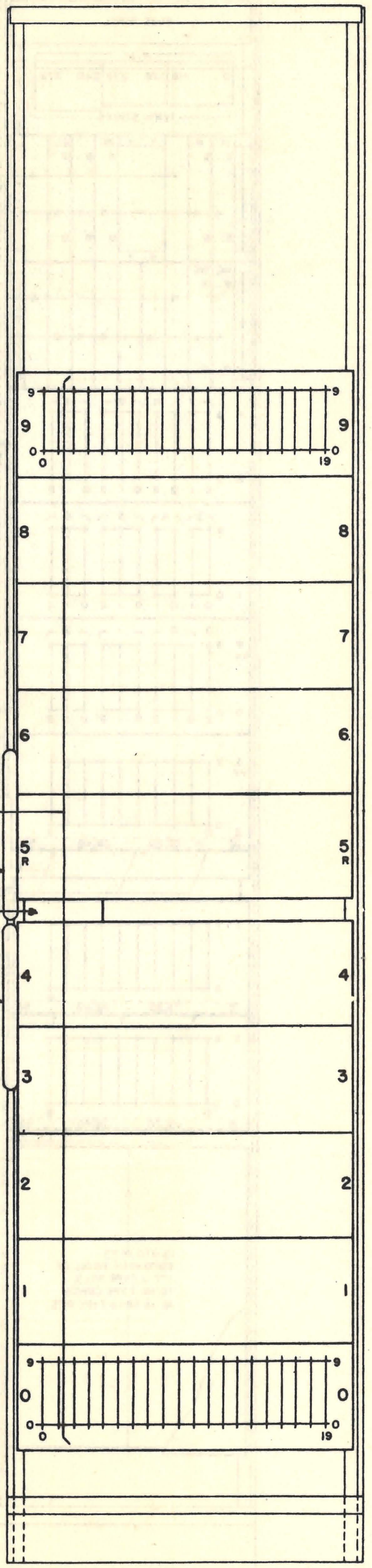

9
8
7
6
5
R
4
3
2
1
0
19

Fig. 3B - Incoming Link Extension Frame

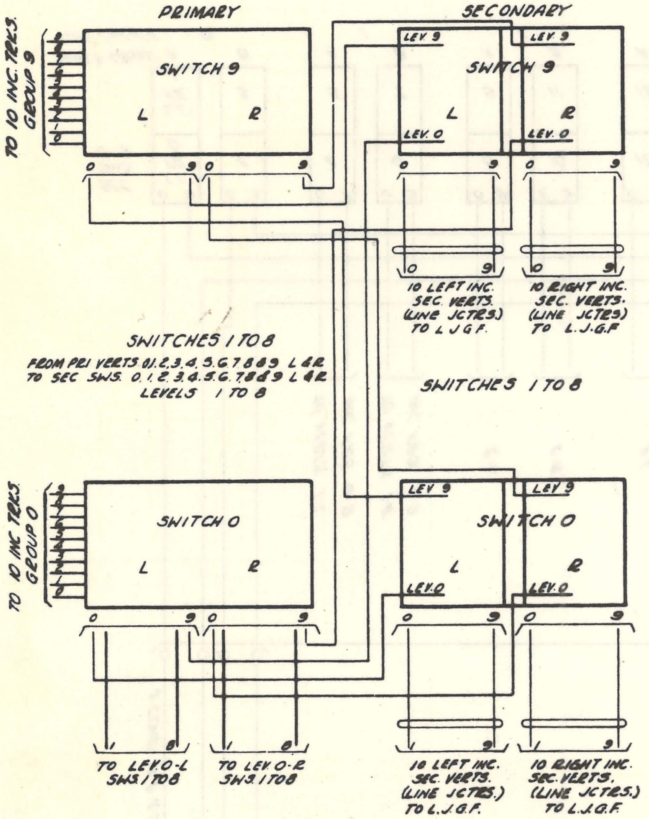

TO 10 INC. TRKS. GROUP 9
PRIMARY
SWITCH 9
L
R
0
9
SECONDARY
LEV. 9
LEV. 0
SWITCH 9
10 LEFT INC. SEC. VERTS. (LINE JCTRS.) TO L.J.G.F.
10 RIGHT INC. SEC. VERTS. (LINE JCTRS) TO L.J.G.F
SWITCHES 1 TO 8
FROM PRI VERTS 0,1,2,3,4,5,6,7,8 & 9 L & R
TO SEC SWS. 0,1,2,3,4,5,6,7,8 & 9 L & R
LEVELS 1 TO 8
SWITCHES 1 TO 8
TO 10 INC. TRKS. GROUP 0
SWITCH 0
SWITCH 0
1
8
TO LEV. 0-L SWS. 1 TO 8
TO LEV. 0-R SWS. 1 TO 8
10 LEFT INC. SEC. VERTS. (LINE JCTRS.) TO L.J.G.F.
10 RIGHT INC. SEC. VERTS. (LINE JCTRS.) TO L.J.G.F.

Fig. 4A - Primary-Secondary Switch Slip Incoming Link Frame Without Extension Frame - 200 Line Junctors Per Incoming Link Frame

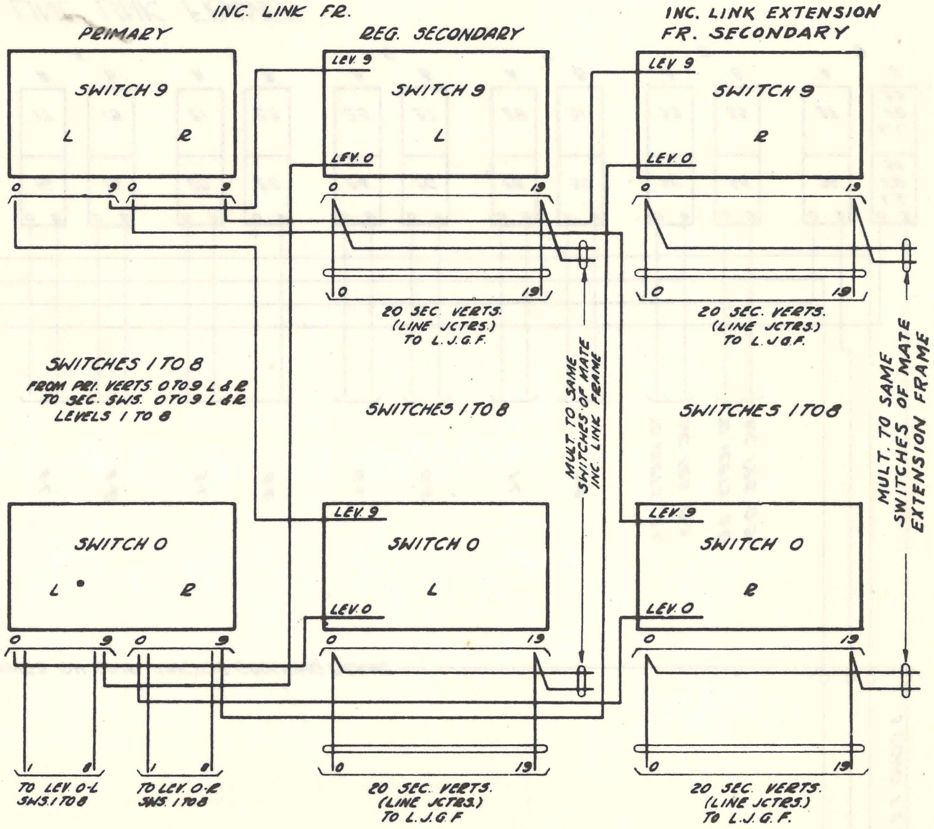

INC. LINK FR.
PRIMARY
REG. SECONDARY
INC. LINK EXTENSION FR. SECONDARY
SWITCH 9
L
R
LEV. 9
LEV. 0
0
9
19
20 SEC. VERTS. (LINE JCTRS.) TO L.J.G.F.
20 SEC. VERTS. (LINE JCTRS.) TO L.J.G.F.
SWITCHES 1 TO 8
FROM PRI. VERTS. 0 TO 9 L & R
TO SEC. SWS. 0 TO 9 L & R
LEVELS 1 TO 8
SWITCHES 1 TO 8
SWITCHES 1 TO 8
MULT. TO SAME SWITCHES OF MATE INC. LINK FRAME
MULT. TO SAME SWITCHES OF MATE EXTENSION FRAME
SWITCH 0
1
8
TO LEV. 0-L SWS. 1 TO 8
TO LEV. 0-R SWS. 1 TO 8
20 SEC. VERTS. (LINE JCTRS.) TO L.J.G.F
20 SEC. VERTS. (LINE JCTRS.) TO L.J.G.F.

Fig. 4B - Primary-Secondary Switch Slip Incoming Link Frame With Extension Frame - 400 Line Junctors Per Incoming Link Group

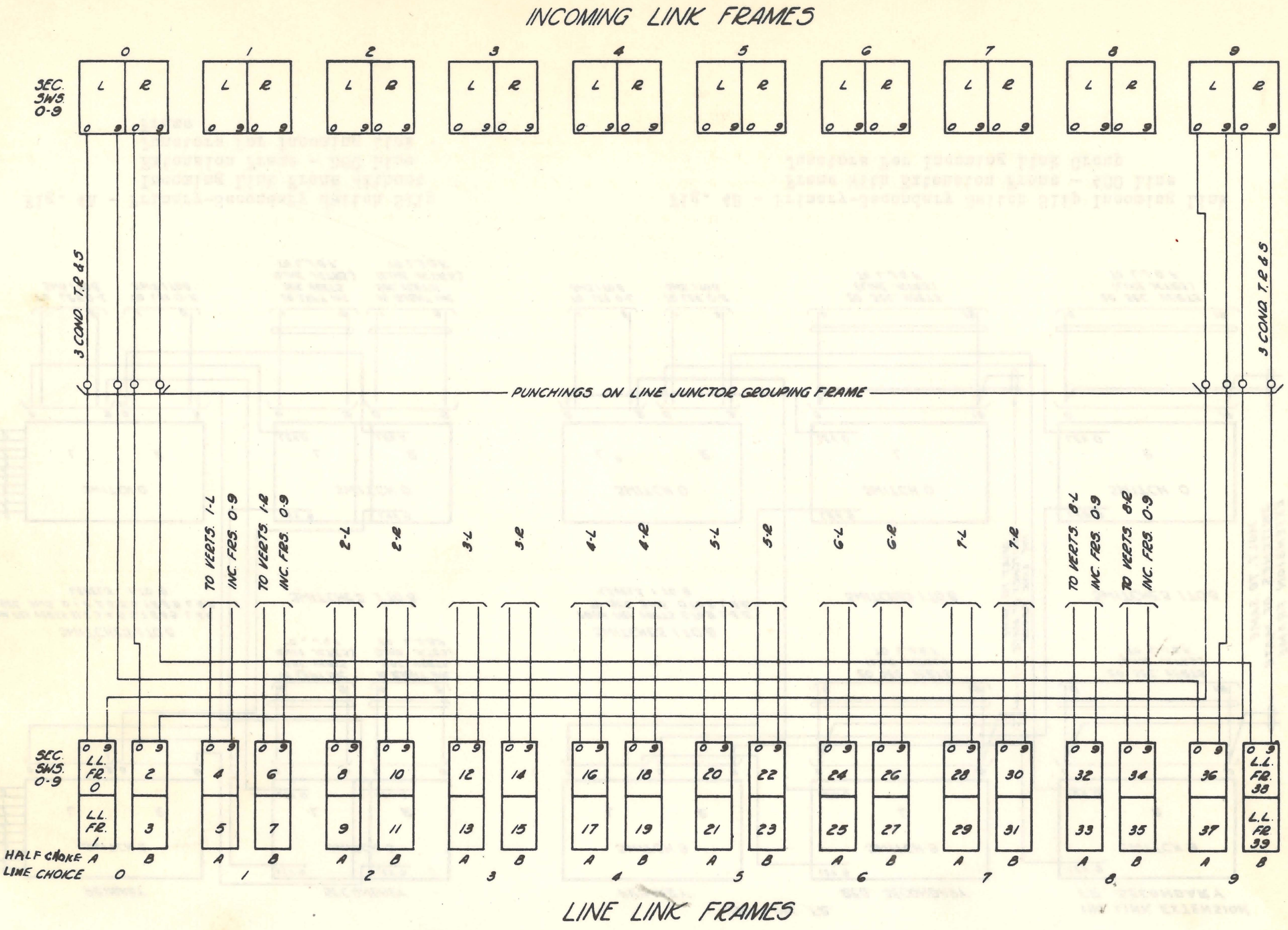

INCOMING LINK FRAMES
0
1
2
3
4
5
6
7
8
9
SEC. SWS. 0-9
L
R
0 9 0 9
3 COND. T.R & S
PUNCHINGS ON LINE JUNCTOR GROUPING FRAME
TO VERTS. 1-L INC. FRS. 0-9
TO VERTS. 1-R INC. FRS. 0-9
2-L
2-R
3-L
3-R
4-L
4-R
5-L
5-R
6-L
6-R
7-L
7-R
TO VERTS. 8-L INC. FRS. 0-9
TO VERTS. 8-R INC. FRS. 0-9
SEC. SWS. 0-9
L.L. FR. 0
L.L. FR. 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
L.L. FR. 38
L.L. FR. 39
HALF CHOICE
A
B
LINE CHOICE
0
1
2
3
4
5
6
7
8
9
LINE LINK FRAMES

Fig. 5 - Line Junctor Connections For Offices With 10 Incoming Frames And 10 Line Choices - 200 Junctors Per Incoming Link

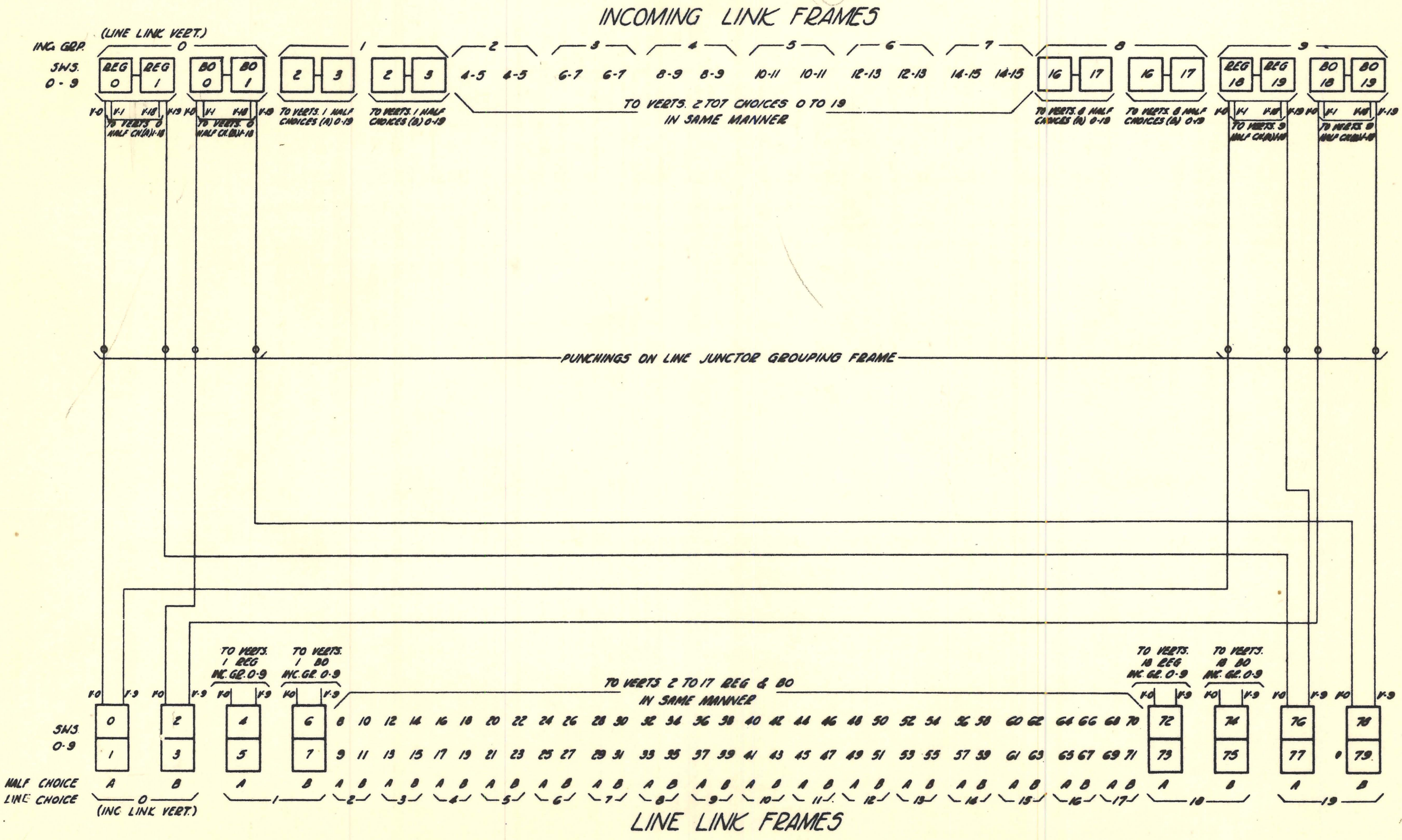

INCOMING LINK FRAMES
(LINE LINK VERT.)
INC. GRP.
SWS. 0 - 9
0
REG 0
REG 1
BO 0
BO 1
V-0 V-1 V-18 V-19
TO VERTS. 0 HALF CH.(A) V-1-18
TO VERTS. 0 HALF CH.(B) V-1-18
1
2 3
2 3
TO VERTS. 1 HALF CHOICES (A) 0-19
TO VERTS. 1 HALF CHOICES (B) 0-19
2
4-5 4-5
3
6-7 6-7
4
8-9 8-9
5
10-11 10-11
6
12-13 12-13
7
14-15 14-15
TO VERTS. 2 TO 7 CHOICES 0 TO 19 IN SAME MANNER
8
16 17
16 17
TO VERTS. 8 HALF CHOICES (A) 0-19
TO VERTS. 8 HALF CHOICES (B) 0-19
9
REG 18
REG 19
BO 18
BO 19
TO VERTS. 9 HALF CH.(A) V-1-18
TO VERTS. 9 HALF CH.(B) V-1-18
PUNCHINGS ON LINE JUNCTOR GROUPING FRAME
TO VERTS. 1 REG INC. GR. 0-9
TO VERTS. 1 BO INC. GR. 0-9
TO VERTS 2 TO 17 REG & BO IN SAME MANNER
TO VERTS. 18 REG INC. GR. 0-9
TO VERTS. 18 BO INC. GR. 0-9
V-0 V-9
SWS. 0-9
0 1
2 3
4 5
6 7
8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70
9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67 69 71
72 73
74 75
76 77
78 79
HALF CHOICE
A B A B A B A B A B A B A B A B A B A B A B A B A B A B A B A B A B A B A B A B
LINE CHOICE
0 (INC LINK VERT.)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
LINE LINK FRAMES

Fig. 6 - Line Junctor Connections - 10 Incoming Link Groups And 20 Line Choices - 400 Incoming Link Verticals per Incoming Group

CHAPTER 11 - TERMINATING SENDER, NUMBER GROUP CONNECTOR, BLOCK RELAY, AND TERMINATING MARKER FRAMES - LINE TEST

When the interoffice trunk to a crossbar office is seized in the originating office, and the associated subscriber sender is ready for incoming selections, the incoming trunk circuit in the crossbar office grounds its start lead to the associated terminating sender link controller. This ground will cause the group start equipment, serving the group of ten trunks in which the selected trunk appears, to seize either the home or the mate terminating sender link controller. The controller in conjunction with the sender selector equipment, proceeds to select an idle full selector or "B" sender depending on the type of trunk. The selected sender is then connected to the incoming trunk through an idle sender link and is given an indication as to the number of the link frame on which the particular incoming trunk appears.

FULL SELECTOR AND "B" SENDERS

The terminating sender frame illustrated on Fig. 1 is arranged to mount five full selector or a combination of full selector and "B" senders. The frame is completely wired and equipped in the shop. Sender positions 0 and 1 are arranged for either full selector or "B" senders. Sender positions 2, 3, and 4 are arranged for full selector senders only.

REGISTRATION OF CALLED NUMBER-FULL SELECTOR SENDER

When the connection to a full selector sender has been completed through the terminating sender link frame, a path is provided from the originating sender (either panel or crossbar) over the interoffice trunk and through the terminating sender link switches to the full selector sender. The full selector sender receives the called number from the originating sender by sending revertive pulses simulating the pulses sent back from the commutators of incoming and final selectors in a panel office. Even though the originating sender is in a crossbar office the number is not received by the full selector sender as the four digits set up on the register switch of the originating sender but as incoming brush, incoming group and final brush, tens and units selections. This method is used so that originating and full selector crossbar senders may function on calls to either panel or crossbar offices with a minimum of additional equipment and with no change in the present panel equipment. The above selections are registered on the verticals of a crossbar switch in the full-selector sender. After the number has been received, trunk closure by the district junctor causes the sender to connect itself to a terminating marker through the terminating marker connector frame and transfers the called number to the marker. The marker then proceeds to connect the incoming trunk, on which the call is waiting, to a called line and to release the sender.

REGISTRATION - "B" SENDER

When a manual call comes in on a straightforward trunk to be completed in the crossbar office, a "B" sender is selected through the terminating sender link frame and is connected to the "B" switchboard incoming trunk. As soon as the "B" sender is selected, the "B" position finder seizes an idle call distributing "B" position and makes the necessary connections to enable the crossbar "B" operator to receive the called number verbally from the "A" operator in the manual office. The "B" operator in the crossbar office sets up the called number on her keyset which in turn operates the proper thousands, hundreds, tens, and units relays in the "B" sender to register the call in the sender. When this is accomplished the "B" operator is disconnected and a terminating marker is selected. The "B" sender transfers the called number into the marker which proceeds to complete the call.

NUMBER GROUP CONNECTOR FRAME

The number group connector frame which is a two bay structure arranged for multicontact relays and terminal strips is illustrated on Fig. 5. Each number group connector consists of four multicontact relays per marker which are required to connect the necessary leads between the marker and the block relay frame. Four number group connectors are mounted on each number group connector frame. The frame illustrated has a capacity of ten terminating markers but, if necessary, a frame having a capacity of six terminating markers may be furnished.

The switchboard cables from the various terminating markers are connected to the two rows of terminal strips at the top of the number group connector frame. These leads are then multipled vertically to the corresponding relays for each marker in the various number group connectors. The common or strapping side of the multicontact relays is wired in switchboard cable to the proper block relay frames.

NUMBER GROUP

The 10,000 numbers in a given office are divided into "number groups". A number group consists of a series of consecutive numbers into which all markers have access and in which only one terminating marker may work at a time. The size of a number group depends on the amount of terminating traffic delivered to the numbers. In general, a number group will handle 1,000 busy-hour calls regardless of their duration. Number groups will never be smaller than 100 numbers, however, and are furnished in increments of 100 numbers up to a maximum of 2500 numbers.

For purposes of illustration the size of a number group can be assumed as 1,000 numbers which represents an average traffic condition. Under these circumstances, Fig. 2 illustrates the arrangements which would be required. A number group connector would be required for each 1,000 lines or ten connectors per 10,000 lines. Ten number group connectors are shown on this illustration, four each on number group connector frames 0 and 1 and two connectors on frame 2.

The block relay frames each serve 800 numbers so that each number group connector requires access as shown to more than one block relay frame in order to reach its quota of 1,000 numbers. Twelve fully equipped and one one-half equipped block relay frame are required for the full 10,000 numbers.

This figure also illustrates the relation between the block relay frames and the line circuits of line link frames. The sleeve terminals (directory numbers) of each twenty block relay are cross connected through the line distributing frame, as illustrated, to the sleeve leads of line circuits so that if the correct terminal on a twenty block relay is chosen in accordance with the number dialed (directory number) a sleeve connection is provided to the line circuit on a line link frame.

BLOCK RELAY FRAME

The block relay frame which is a one bay structure equipped with multicontact relays and marker type terminal strips for cross-connections is shown on Fig. 6. This frame accommodates the block relays and terminal strip equipment required for 800 numbers. Where a number group consists of more than 800 numbers, it is spread over more than one block relay frame. The hundred block relays previously referred to are shown on the mounting plates at the top of the frame, eight of these relays being furnished per frame. The twenty block relays consist of multicontact relays, five of which are furnished per 100 numbers.

The sleeves of the various subscriber lines are connected from the twenty block relay terminals direct to the line distributing frame. The "NF" and "NC" leads for each subscriber number are connected from the block relay through the terminal strips on the block relay frame, as indicated on Fig. 4, to give the proper indications to the marker.

TERMINATING MARKER FRAME

Fig. 3 illustrates the terminating marker frame. This frame mounts all equipment required for one terminating marker. The relay equipment, with the exception of multicontact relays, is mounted under the casings as illustrated. The terminal strip facilities provided permit flexibility in the marker in arranging for various sizes of number group, for free lines and for various methods of handling PBX groups.

The terminating marker is responsible for locating and testing the called line and connecting the incoming trunk to it through an idle channel consisting of an incoming link, line junctor and line link. The functions of the terminating marker are divided into two general parts, the location and testing of the called line and the selection of a suitable channel for completing the call.

GENERAL FUNCTIONS

The terminating marker must locate and test a particular called number out of the possible 10,000 numbers which may be reached through a given crossbar office. It is impracticable to give a marker direct access to the entire 10,000 numbers as is done in the case of the "B" operator in the manual office. This would involve cabling and circuit arrangements in the crossbar office which would prove unwieldy and uneconomical. Instead, the marker in conjunction with the number group connector and block relay frames is arranged to locate and test the numbers in groups of twenty. An individual line in the group of twenty will be tested and if idle the marker will set up the connection to it. If the particular number is one of a PBX group and it is busy, the marker will test the other lines to that PBX in the group of twenty and may be required to test other blocks of twenty numbers in order to find an idle line to the required PBX.

CIRCUIT FUNCTIONS

The number recorded in the terminating sender is transferred to the terminating marker through the marker connector frame. In the marker this number is recorded on "thousands", "hundreds", "tens", and "units" register relays. This four digit number (directory number) bears no relation to the location of a line on the line link frame and is, therefore, so far as the line link location is concerned, a numerical "code" which must be translated by the marker before the called line can be located. This translation is done by the marker by determining which hundred numbers in the office and then which twenty in the hundred contains the called number. This translation process is performed by "five hundreds", "hundreds", and "twenty block" translator relays in the marker in conjunction with similar relays on the block relay frame. The association of the marker with the number group connector and block relay frames in performing the various translator functions is illustrated on Fig. 4.

The setting of the thousands and hundreds register relays in the marker controls the operation of the proper five hundreds translator relay and the setting of the hundreds register relays the operation of the hundreds translator relay. The "five hundred" and "hundred" translator relays together determine through which number group the call is to be completed and operate the marker connector relay for the particular marker on the associated number group connector frame. The setting of the tens register relays controls the operation of a "twenty block" relay in the marker.

The marker connector relay on the number group connector frame gives the marker access to the associated block relay frame on which the twenty block relay containing the called number is located. "Hundred block" relays are provided on this frame whose function it is to select the particular hundred numbers on the frame in which the called number appears. The "twenty block" relays on the frame are cross connected through the line distributing frame to the line circuits represented by the associated twenty numbers. The hundred block and twenty block relays on the block relay frame are operated from the corresponding translator relays in the marker. This gives the marker access to the twenty sets of test leads for the twenty numbers represented on the twenty block relay.

Three leads per line are connected to the marker by the twenty block relay on the block relay frame. These are the "NS", "NF", and "NC" leads. The "NS" lead is cross connected to the line sleeve. The "NF" lead is cross connected to indicate the line choice in which the called line appears, the side of the line on which ringing current is to be sent out and whether the called line is an individual line or one of a hunting group. The "NC" lead is cross connected to indicate the particular line link frame of the line choice and the horizontal group on that line link frame in which the called line is located.

The twenty sets of test leads are connected in the marker to twenty sets of test relays. If the called line is busy a test relay will be operated which will cause the marker to set the incoming trunk for a busy back indication. If the line is idle, another test relay will be operated which will cause the marker to complete the call in accordance with the line choice, line link, and horizontal group indications received from the twenty block relay. If the line is one of a PBX group the marker tests all lines in the group and selects one which is idle. After the call is completed to the called line the incoming trunk will send out ringing current on the side of the line indicated by the marker and the terminating marker will disconnect.

PBX LINES

PBX groups may be handled in various ways. The group may be small enough to consist of consecutive numbers on one twenty block relay in which case the marker tests all lines in the group without operating another twenty block relay. When all lines in the group tested are busy, the busy back condition will be returned to the calling subscriber by the incoming trunk.

Numbers in PBX groups should be assigned in consecutive order as far as possible. When a PBX group is large enough to appear on more than one twenty block relay the marker must transfer the "hunting" process from one twenty block relay to another. When the numbers are consecutive this transfer will be accomplished when the last number of the twenty block is reached and the testing will proceed in the next consecutive twenty block.

Under certain circumstances, however, the numbers in a PBX group will not be consecutive. This occurs when additions must be made to the group of lines serving a PBX and the next numbers are already assigned. In this case a process known as "jump hunting" is employed which causes the hunting progress to cease with the last number assigned to the PBX group on one twenty block relay and recommence on another twenty block relay with the added lines. This procedure is irregular, however, and should be avoided wherever possible.

For a heavily loaded PBX the lines may be spread over more than one number group. This assumes that if all the lines for such a PBX were put in the one number group, the number group would be overloaded. The PBX group is, therefore, split between two number groups with approximately half the numbers in each number group. A feature of the marker permits calls to this PBX to be allotted approximately equal to the two number groups.

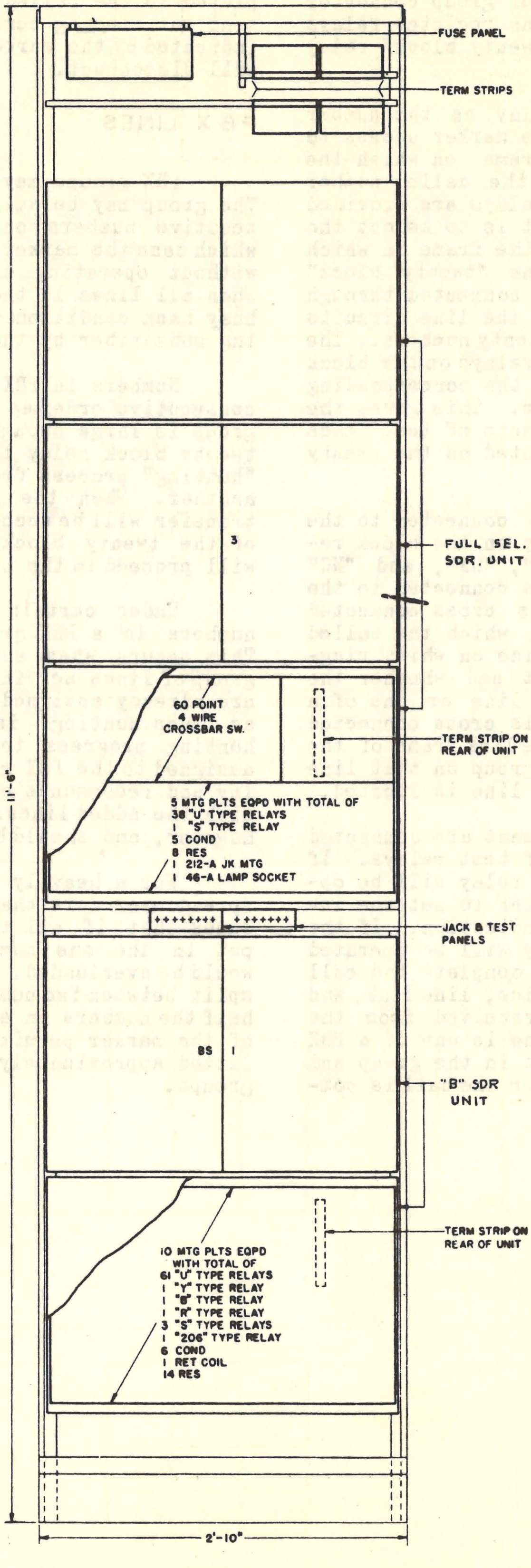

FUSE PANEL
TERM STRIPS
3
FULL SEL. SDR. UNIT
60 POINT 4 WIRE CROSSBAR SW.
TERM STRIP ON REAR OF UNIT
11'-6"
5 MTG PLTS EQPD WITH TOTAL OF
38 "U" TYPE RELAYS
1 "S" TYPE RELAY
5 COND
8 RES
1 212-A JK MTG
1 46-A LAMP SOCKET
JACK & TEST PANELS
BS 1
"B" SDR UNIT
TERM STRIP ON REAR OF UNIT
10 MTG PLTS EQPD WITH TOTAL OF
61 "U" TYPE RELAYS
1 "Y" TYPE RELAY
1 "B" TYPE RELAY
1 "R" TYPE RELAY
3 "S" TYPE RELAYS
1 "206" TYPE RELAY
6 COND
1 RET COIL
14 RES
2'-10"

Fig. 1 - Terminating Sender Frame

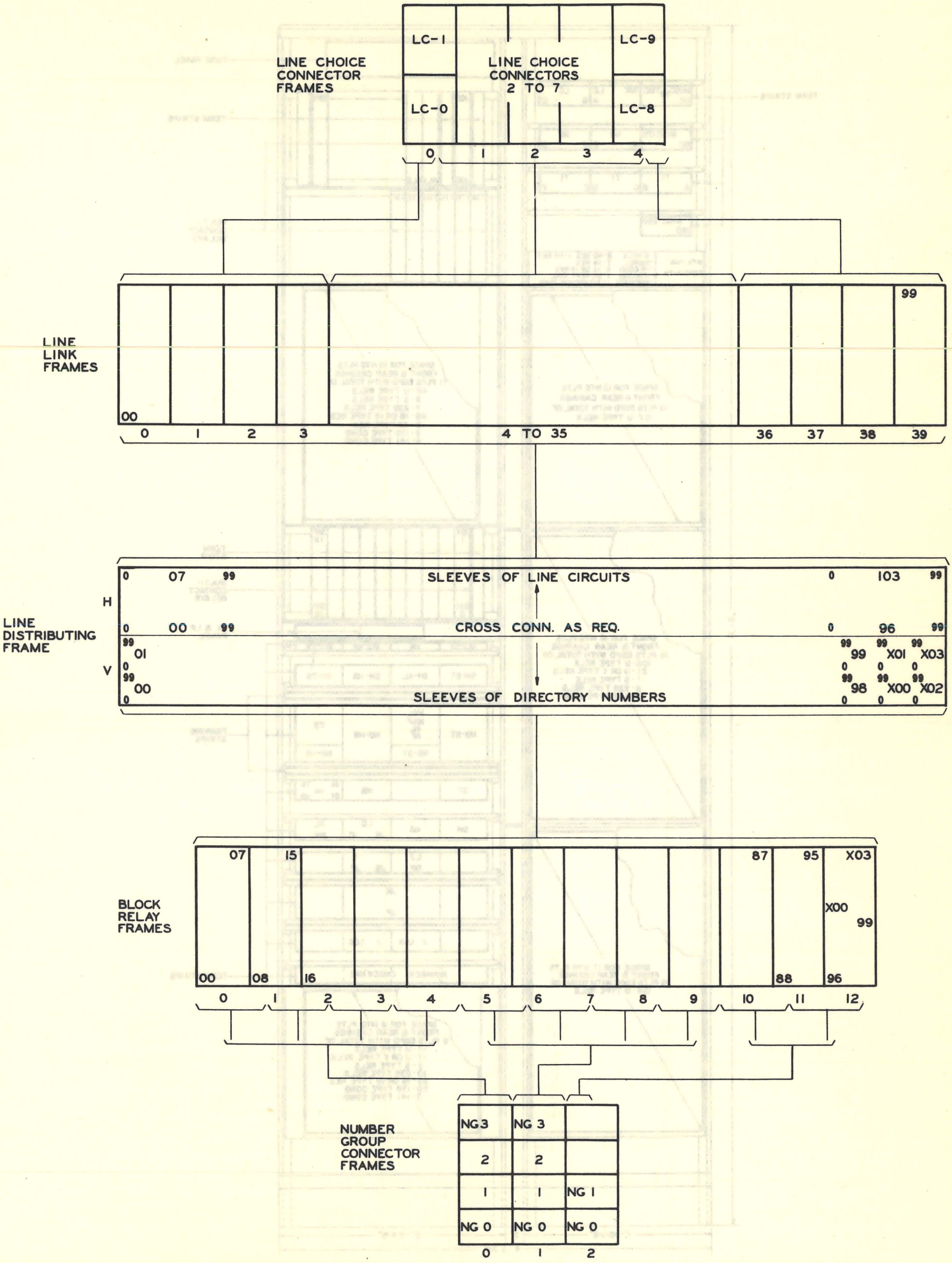

LINE CHOICE CONNECTOR FRAMES
LC-1
LC-0
LINE CHOICE CONNECTORS 2 TO 7
LC-9
LC-8
0
1
2
3
4
LINE LINK FRAMES
00
99
0
1
2
3
4 TO 35
36
37
38
39
LINE DISTRIBUTING FRAME
H
V
0
07
99
SLEEVES OF LINE CIRCUITS
103
00
CROSS CONN. AS REQ.
96
01
00
99
98
X01
X03
X00
X02
SLEEVES OF DIRECTORY NUMBERS
BLOCK RELAY FRAMES
07
15
87
95
X03
X00
99
00
08
16
88
96
0
1
2
3
4
5
6
7
8
9
10
11
12
NUMBER GROUP CONNECTOR FRAMES
NG3
NG 3
2
2
1
1
NG 1
NG 0
NG 0
NG 0
0
1
2

Fig. 2 - Schematic of Association of Line Choice Connector, Line Link, Line Distributing, Block Relay and Number Group Connector Frames

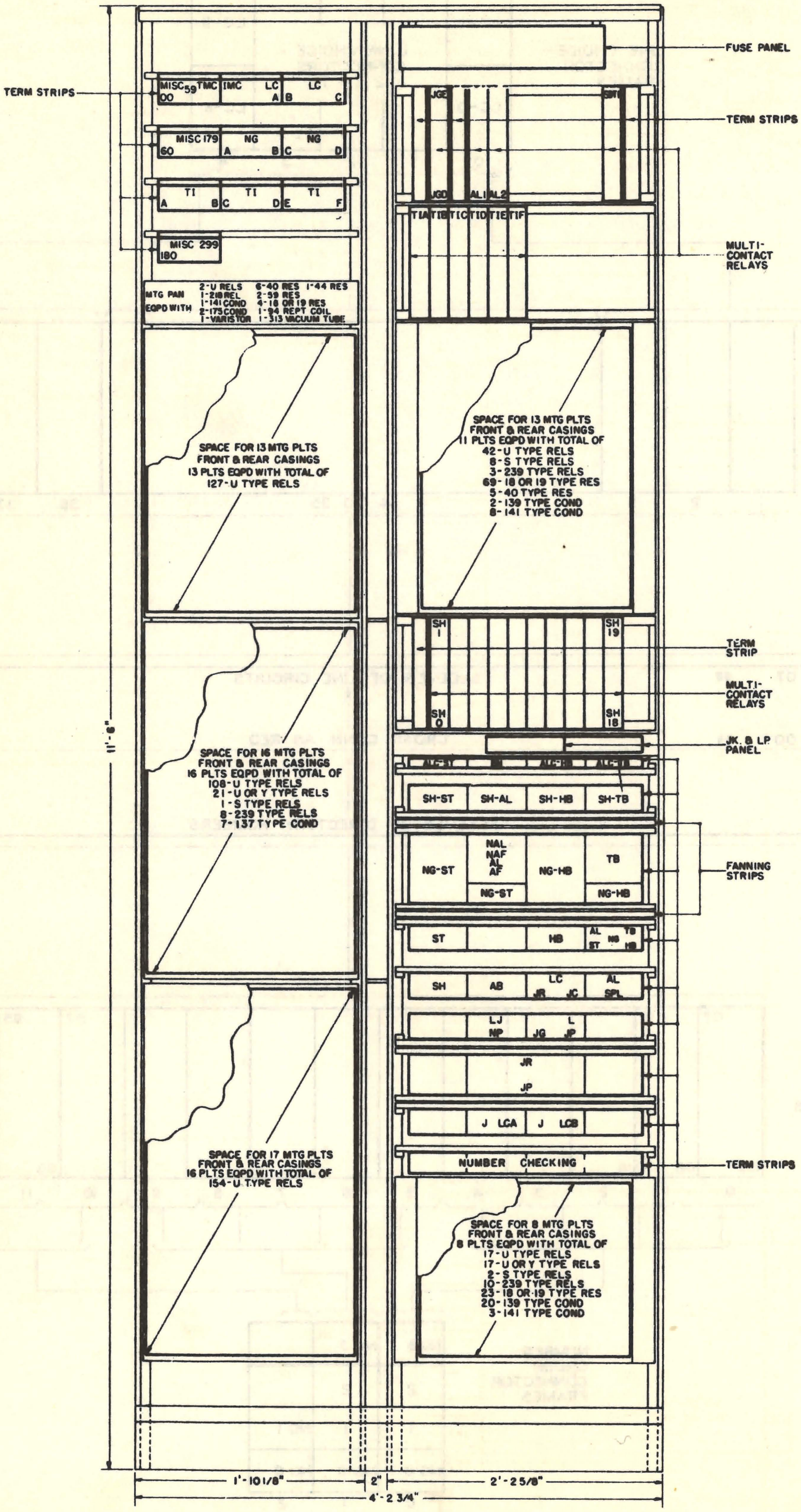

TERM STRIPS
MISC 59 00
TMC
IMC
LC A
LC B C
MISC 179 60
NG A B
NG C D
TI A B
TI C D
TI E F
MISC 299 180
MTG PAN EQPD WITH
2-U RELS
1-218 REL
1-141 COND
2-175 COND
1-VARISTOR
6-40 RES
2-59 RES
4-18 OR 19 RES
1-94 REPT COIL
1-313 VACUUM TUBE
1-44 RES
SPACE FOR 13 MTG PLTS FRONT & REAR CASINGS 13 PLTS EQPD WITH TOTAL OF 127-U TYPE RELS
SPACE FOR 16 MTG PLTS FRONT & REAR CASINGS 16 PLTS EQPD WITH TOTAL OF 108-U TYPE RELS 21-U OR Y TYPE RELS 1-S TYPE RELS 8-239 TYPE RELS 7-137 TYPE COND
SPACE FOR 17 MTG PLTS FRONT & REAR CASINGS 16 PLTS EQPD WITH TOTAL OF 154-U TYPE RELS
11'-6"
FUSE PANEL
JGE
JGD
AL1
AL2
TERM STRIPS
TIA TIB TIC TID TIE TIF
MULTI-CONTACT RELAYS
SPACE FOR 13 MTG PLTS FRONT & REAR CASINGS 11 PLTS EQPD WITH TOTAL OF 42-U TYPE RELS 8-S TYPE RELS 3-239 TYPE RELS 69-18 OR 19 TYPE RES 5-40 TYPE RES 2-139 TYPE COND 8-141 TYPE COND
SH 1
SH 19
SH 0
SH 18
TERM STRIP
MULTI-CONTACT RELAYS
JK. & LP. PANEL
SH-ST
SH-AL
SH-HB
SH-TB
NG-ST
NAL NAF AL AF
NG-ST
NG-HB
TB
NG-HB
FANNING STRIPS
ST
HB
AL ST NG TB HB
SH
AB
LC JR JC
AL SPL
LJ NP
JG
L JP
JR
JP
J LCA
J LCB
NUMBER CHECKING
TERM STRIPS
SPACE FOR 8 MTG PLTS FRONT & REAR CASINGS 8 PLTS EQPD WITH TOTAL OF 17-U TYPE RELS 17-U OR Y TYPE RELS 2-S TYPE RELS 10-239 TYPE RELS 23-18 OR 19 TYPE RES 20-139 TYPE COND 3-141 TYPE COND
1'-10 1/8"
2"
2'-2 5/8"
4'-2 3/4"

Fig. 3 - Terminating Marker Frame

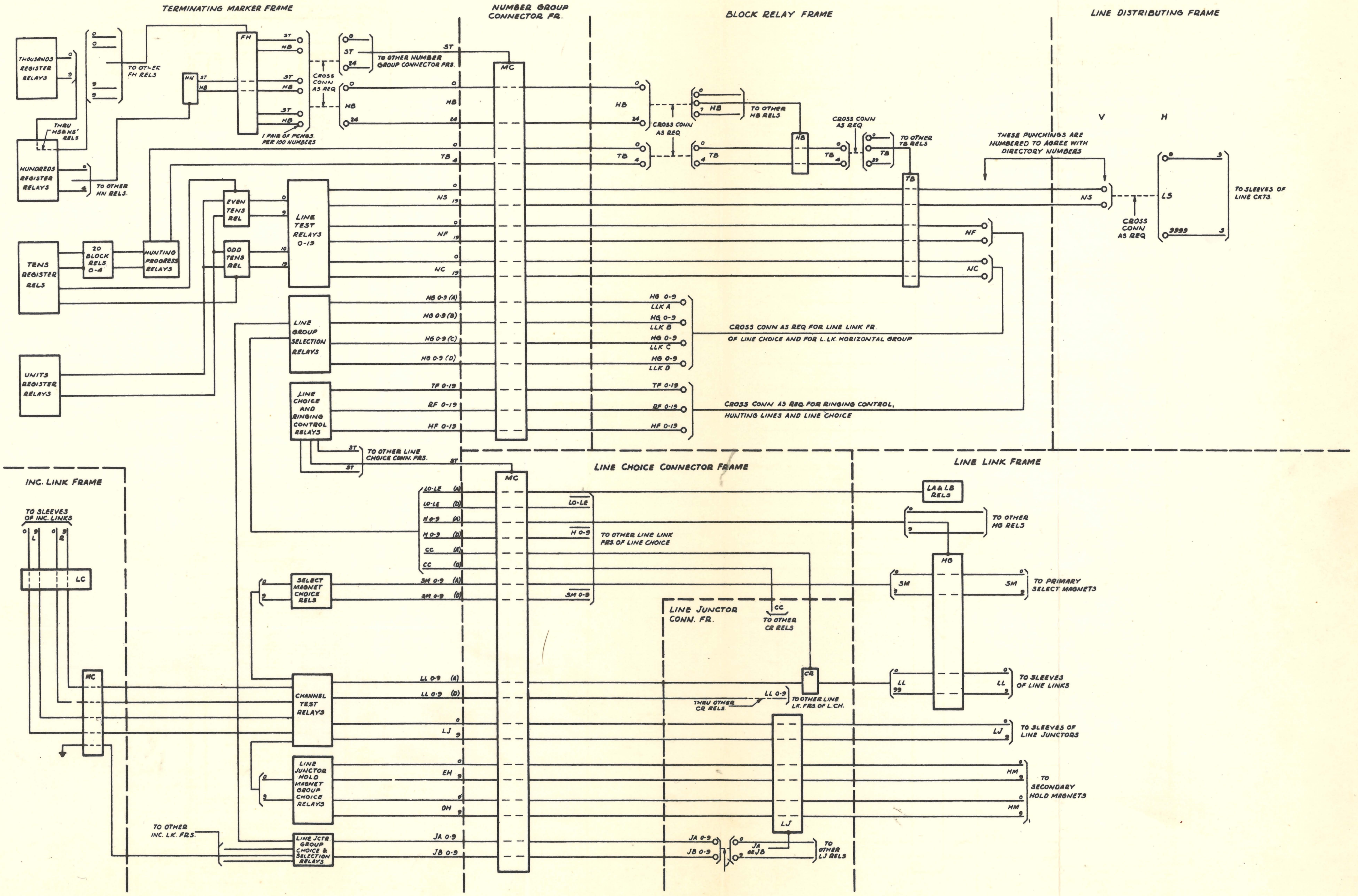

TERMINATING MARKER FRAME
NUMBER GROUP CONNECTOR FR.
BLOCK RELAY FRAME
LINE DISTRIBUTING FRAME
THOUSANDS REGISTER RELAYS
TO OTHER FH RELS
FH
HN
ST
HB
CROSS CONN AS REQ
TO OTHER NUMBER GROUP CONNECTOR FRS.
1 PAIR OF PCHGS. PER 100 NUMBERS
THRU HS & HS' RELS
HUNDREDS REGISTER RELAYS
TO OTHER HN RELS.
EVEN TENS REL
ODD TENS REL
LINE TEST RELAYS 0-19
TENS REGISTER RELS
20 BLOCK RELS 0-4
HUNTING PROGRESS RELAYS
LINE GROUP SELECTION RELAYS
UNITS REGISTER RELAYS
LINE CHOICE AND RINGING CONTROL RELAYS
TO OTHER LINE CHOICE CONN. FRS.
MC
TB
NS
NF
NC
HG 0-9 (A)
HG 0-9 (B)
HG 0-9 (C)
HG 0-9 (D)
TF 0-19
RF 0-19
HF 0-19
TO OTHER HB RELS.
TO OTHER TB RELS
HG 0-9 LLK A
HG 0-9 LLK B
HG 0-9 LLK C
HG 0-9 LLK D
CROSS CONN AS REQ FOR LINE LINK FR. OF LINE CHOICE AND FOR L. LK. HORIZONTAL GROUP
CROSS CONN AS REQ. FOR RINGING CONTROL, HUNTING LINES AND LINE CHOICE
THESE PUNCHINGS ARE NUMBERED TO AGREE WITH DIRECTORY NUMBERS
V
H
LS
9999
TO SLEEVES OF LINE CKTS.
INC. LINK FRAME
TO SLEEVES OF INC. LINKS
L
R
LC
LINE CHOICE CONNECTOR FRAME
LINE LINK FRAME
LO-LE (A)
LO-LE (D)
H 0-9 (A)
H 0-9 (D)
CC (A)
CC (D)
SM 0-9 (A)
SM 0-9 (D)
SELECT MAGNET CHOICE RELS
TO OTHER LINE LINK FRS. OF LINE CHOICE
LA & LB RELS
TO OTHER HG RELS
HG
SM
TO PRIMARY SELECT MAGNETS
LINE JUNCTOR CONN. FR.
CC
TO OTHER CR RELS
CR
LL 0-9 (A)
LL 0-9 (D)
THRU OTHER CR RELS
TO OTHER LINE LK. FRS. OF L. CH.
LL
TO SLEEVES OF LINE LINKS
CHANNEL TEST RELAYS
LJ
TO SLEEVES OF LINE JUNCTORS
LINE JUNCTOR HOLD MAGNET GROUP CHOICE RELAYS
EH
OH
HM
TO SECONDARY HOLD MAGNETS
TO OTHER INC. LK. FRS.
LINE JCTR. GROUP CHOICE & SELECTION RELAYS
JA 0-9
JB 0-9
JA or JB
TO OTHER LJ RELS

Fig. 4 - Terminating Frames Schematic Showing Method Of Locating, Testing, and Connecting To A Called Line

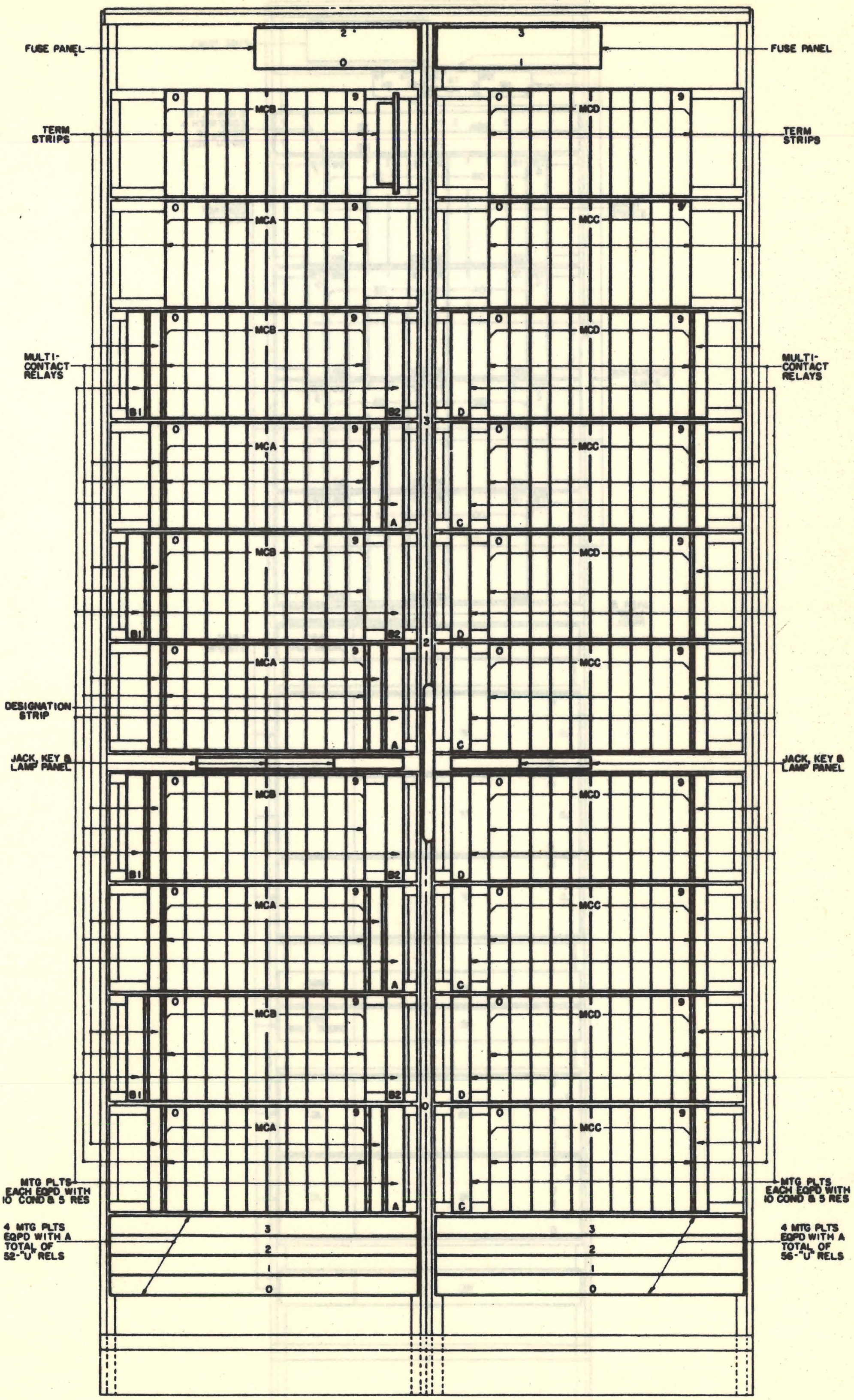

FUSE PANEL
2
0
3
1
FUSE PANEL
TERM STRIPS
TERM STRIPS
MCB
MCA
MCD
MCC
MULTI-CONTACT RELAYS
MULTI-CONTACT RELAYS
B1
B2
A
C
D
3
2
1
0
9
DESIGNATION STRIP
JACK, KEY & LAMP PANEL
JACK, KEY & LAMP PANEL
MTG PLTS EACH EQPD WITH 10 COND & 5 RES
MTG PLTS EACH EQPD WITH 10 COND & 5 RES
4 MTG PLTS EQPD WITH A TOTAL OF 52-"U" RELS
4 MTG PLTS EQPD WITH A TOTAL OF 56-"U" RELS

Fig. 5 - Number Group Connector Frame

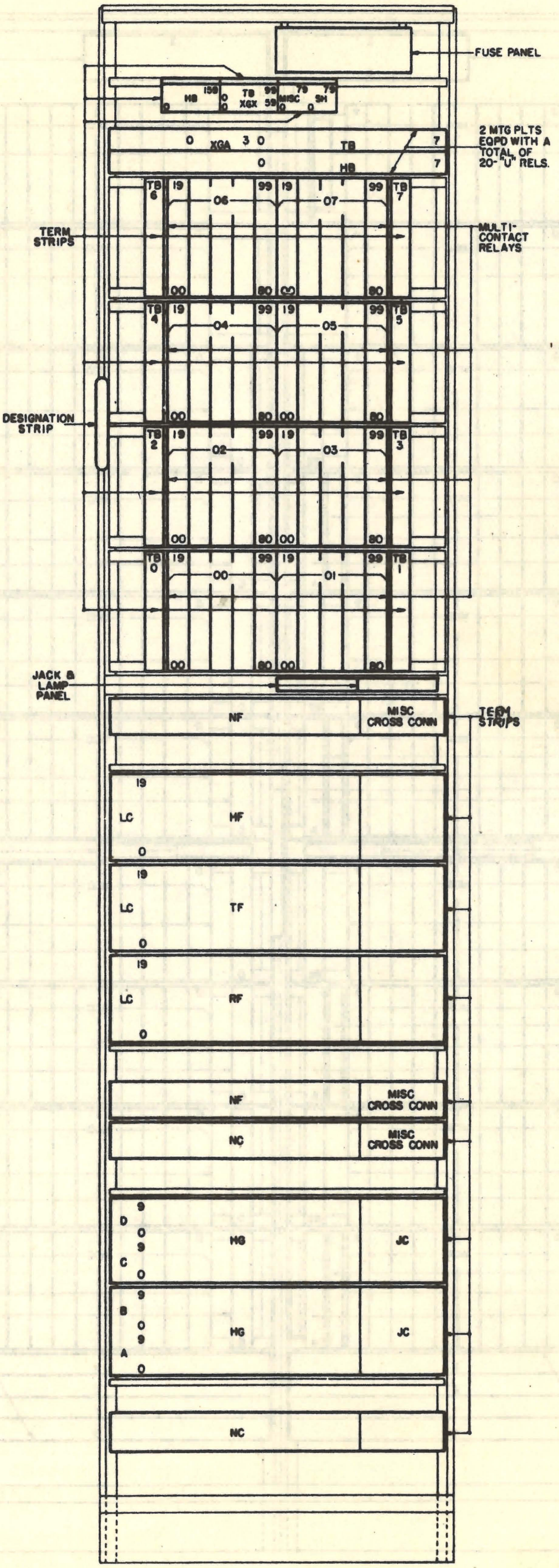

FUSE PANEL
HB
159
TB
XGX
99
59
MISC
79
SH
XGA
TB
HB
2 MTG PLTS EQPD WITH A TOTAL OF 20- "U" RELS.
TERM STRIPS
MULTI-CONTACT RELAYS
TB 6
TB 7
06
07
TB 4
TB 5
04
05
TB 2
TB 3
02
03
TB 0
TB 1
00
01
DESIGNATION STRIP
JACK & LAMP PANEL
NF
MISC CROSS CONN
TERM STRIPS
LC
HF
TF
RF
NF
MISC CROSS CONN
NC
MISC CROSS CONN
D
C
HG
JC
B
A
HG
JC
NC

Fig. 6 - Block Relay Frame

CHAPTER 12 - LINE CHOICE CONNECTOR, LINE JUNCTOR CONNECTOR, AND TERMINATING MARKER FRAMES - CHANNEL SELECTION - TROUBLE INDICATORS

The previous chapter discussed methods by which the terminating marker with the aid of the number group connector and block relay frames locates and tests the called number. The marker uses these frames as a reference in translating the numerical code (directory number) in terms of the location of the called line in a particular line choice, on a particular line link frame and in a particular horizontal group. After the translation process, the marker maintains the connection over the sleeve through the block relay frame. This connection will not interfere with originating traffic. The sleeve connection is used to operate the line holding magnet after the channel for completing the call has been selected.

The present chapter discusses the means by which the marker obtains control over the various channels through which the call may be completed from the waiting trunk to the called line. For this purpose it requires access to the incoming links, line junctors, and line links which form the available channels and it must have momentary control over the line controller of the line link frame in order to shut out other originating and terminating calls which may be waiting.

The terminating marker obtains access to the incoming links which are available for the connection through a link connector relay on the incoming link frame. This relay connects the test leads for twenty links (ten left and ten right) into the marker although only ten may be used on a call to a given half choice.

The marker obtains access to the test leads of the line junctors and line links through a line choice connector. As previously defined, a line choice is the association of four line link frames which the marker treats as a unit in setting up connections from incoming links to lines.

LINE CHOICE CONNECTOR FRAME

Fig. 1 illustrates the arrangements of a line choice connector frame with a maximum capacity of ten terminating markers. A frame is also available which has a capacity of six markers.

The line choice connector frame accommodates the equipment required for two line choice connectors. Each connector consists of multicontact relays which cut through a number of control leads from the marker to the four line link frames of the choice and to a set of junctor connector relays on the line junctor connector frame, for test and control in completing calls. The leads to the line link frames permit the marker to operate the proper horizontal group relay and to test and control the ten line links to the called line.

LINE JUNCTOR CONNECTOR FRAME

Fig. 2 illustrates the arrangement of the line junctor connector frame. This frame mounts the line junctor connector relays required to give the marker access to the test leads of the line junctors to a particular half choice, (A or B). The frame mounts the line junctor connector relays required for four line choices. One multicontact relay is furnished for each ten junctors to a half choice.

CHANNEL TEST

As soon as the marker has received the line choice, line link, horizontal group, etc. information from the block relay, it is ready to select an idle channel consisting of an incoming link, line junctor, and line link. This choice is made by means of channel test relays which function in a manner similar to that described for the originating marker except that channels are tested in groups of ten instead of groups of twenty.

There are ten line links having access to the called line. There are ten incoming links from the primary half switch on which the waiting trunk appears which have access through the secondary half switches to line junctors to the correct half choice. The line junctors are also tested in groups of ten although there may be succeeding tests of such groups if there are more than ten line junctors to the particular half choice.

The terminating marker operates its associated marker connector relays in the line choice connector. Through these relays it reaches the line link frame where the correct (HG) relay is operated giving the marker access to the test leads of ten line links. Through the line choice connector the marker also reaches the line junctor connector where the (LJ) relay representing line junctors to the correct half choice is operated giving the marker access to the test leads of ten line junctors.

The marker by testing the available channels selects an idle combination of incoming link, line junctor, and line link and operates the necessary magnets to connect the incoming trunk to the calling line over these paths.

The marker sets the incoming trunk to ring on the proper side of the line. As soon as this is accomplished, the marker releases the terminating sender and all connector equipment and disconnects itself from the call.

TROUBLE INDICATOR FRAMES

Associated with the originating and terminating markers are trouble indicator frames. These are combined maintenance and test frames used to facilitate the location of troubles in the marker and to check its operation by:

(a) Taking a record of the information set up in the marker when it fails to complete its functions on normal service calls in the allowed time.

(b) Setting up a test call in a marker, allowing it to perform its functions, and then taking a record of the resulting translations and progress of the test call.

ORIGINATING TROUBLE INDICATOR

The originating trouble indicator will be summoned by any originating marker which fails, for any reason to complete its functions and release in a predetermined time. During the time that the marker is connected to the trouble indicator a record is set up in the trouble indicator of all information registered in the marker which may be of assistance to the maintenance man in tracing the source of the trouble condition. After the record has been taken the marker disconnects, and an alarm is sounded to summon a maintenance man. The record is displayed on lamps on the trouble indicator frame.

The information recorded on the trouble indicator frame includes the following items:

(a) Number of originating marker

(b) Location of marker connector

(c) Number of subscriber sender

(d) Office code as received from sender

(e) Class of service of subscriber

(f) District link frame number

(g) The translation information (OB, OG, CR, etc.) sent to the sender by the marker

(h) Number of district junctor circuit on district frame

(i) Office link frame number

(j) Outgoing trunk level chosen by marker

(k) Channel selected by marker to handle call

(l) Various troubles which may be encountered by marker in handling call

From the above discussion it appears that the trouble indicator is of great assistance to the maintenance people in locating many trouble conditions which may exist not only in the marker but also in the district and office links and in portions of the district junctor and sender circuits. It should be emphasized, however, that the trouble indicator cannot record wrong dialing by the subscriber or wrong registration of the code dialed into the sender.

Only one originating marker may cause a record to be made in the trouble indicator at a time. In the event that other markers summon the trouble indicator while it is taking or holding a record from one marker, they will be signaled to give a trouble release to their associated senders and to return to normal. The trouble indicator will, however, record the numbers of originating markers which summon it while it is busy.

TERMINATING TROUBLE INDICATOR

The terminating trouble indicator functions in a similar manner to the above, in conjunction with terminating markers. When summoned by a terminating marker the trouble indicator records information which includes the following:

(a) The number of the terminating marker

(b) The location of the terminating marker connector used on the call

(c) The sender number

(d) The digits of the called number as received by the marker from the terminating sender

(e) The number of the incoming link and connector frame

(f) The number group connector circuit chosen by marker

(g) The hundred and the twenty blocks chosen by the marker

(h) The line choice connector number

(i) The line link frame and horizontal group chosen

(j) The individual line holding magnet which was operated

(k) The incoming trunk number

(l) The channel selected for the call

(m) The ringing, busy back or overflow conditions set up by the marker

(n) Various trouble conditions which may have been encountered by the marker in attempting to complete the call

The terminating trouble indicator will not indicate whether the called number was correctly transferred from the originating to the terminating sender.

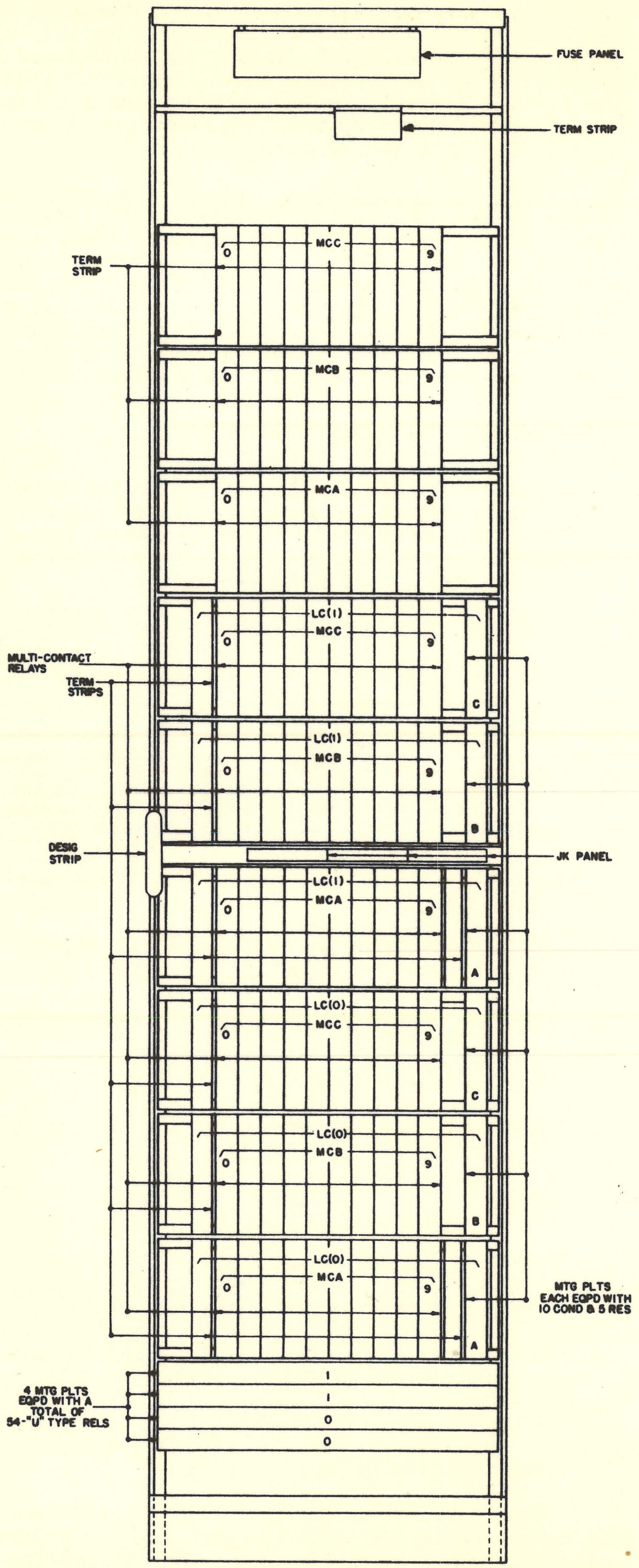

FUSE PANEL
TERM STRIP
TERM STRIP
MCC
0
9
MCB
MCA
MULTI-CONTACT RELAYS
TERM STRIPS
LC(1)
MCC
C
LC(1)
MCB
B
DESIG STRIP
JK PANEL
LC(1)
MCA
A
LC(0)
MCC
C
LC(0)
MCB
B
LC(0)
MCA
A
MTG PLTS EACH EQPD WITH 10 COND & 5 RES
4 MTG PLTS EQPD WITH A TOTAL OF 54-"U" TYPE RELS
1
1
0
0

Fig. 1 - Line Choice Connector Frame

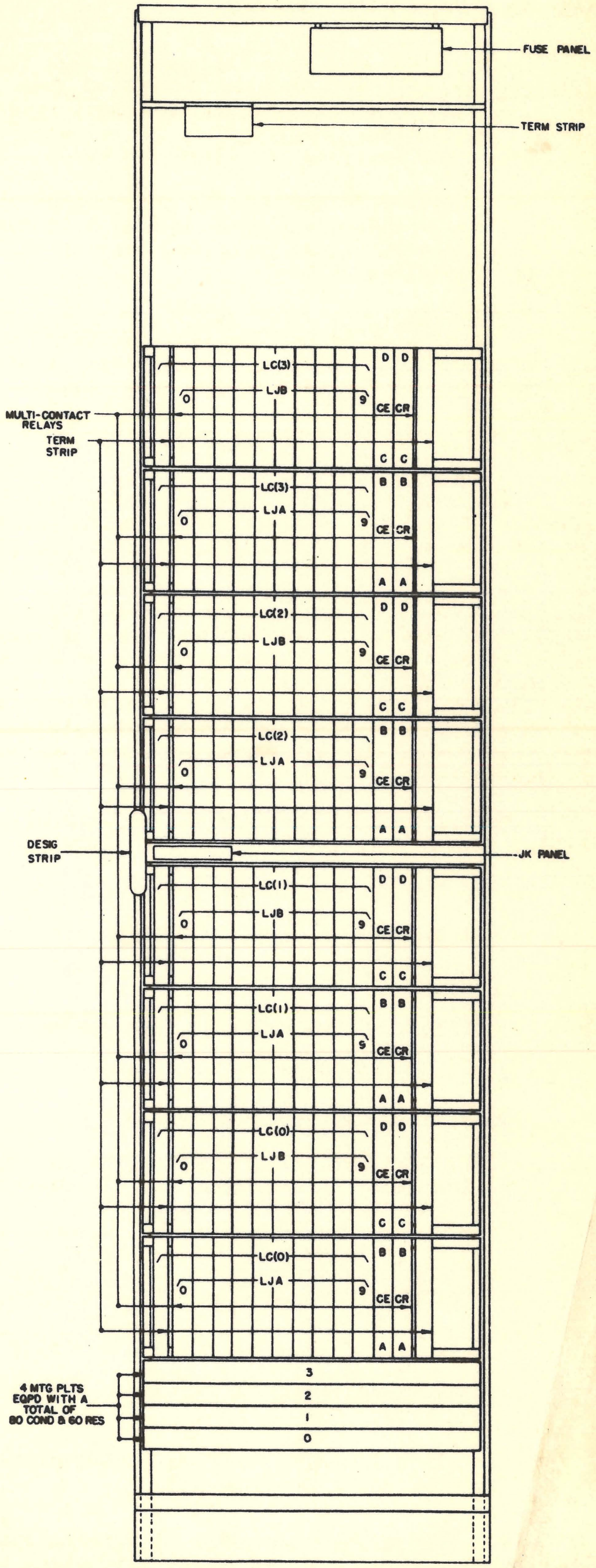

FUSE PANEL
TERM STRIP
MULTI-CONTACT RELAYS
TERM STRIP
LC(3)
LJB
0
9
D D
CE CR
C C
LC(3)
LJA
B B
A A
LC(2)
LJB
LC(2)
LJA
DESIG STRIP
JK PANEL
LC(1)
LJB
LC(1)
LJA
LC(0)
LJB
LC(0)
LJA
4 MTG PLTS EQPD WITH A TOTAL OF 80 COND & 60 RES
3
2
1
0

Fig. 2 - Line Junctor Connector Frame